20120: 25802001

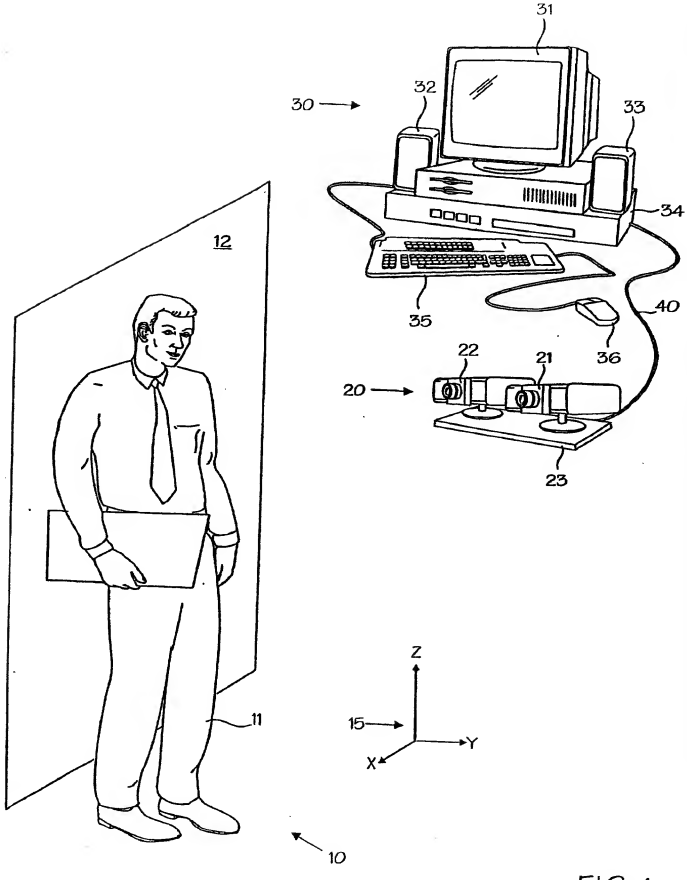


FIG. 1

20122.0 2980201

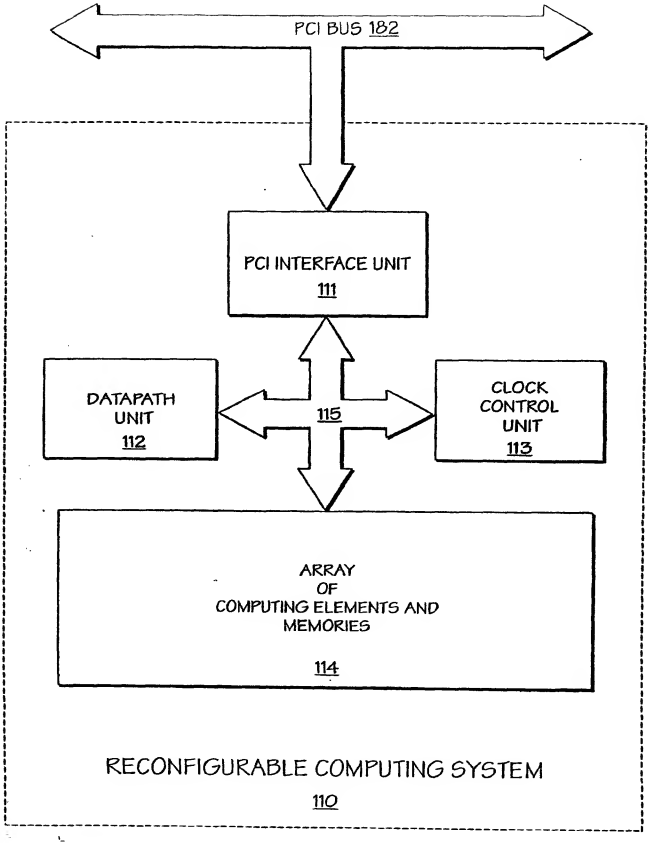


FIG. 3

20020220-2380200

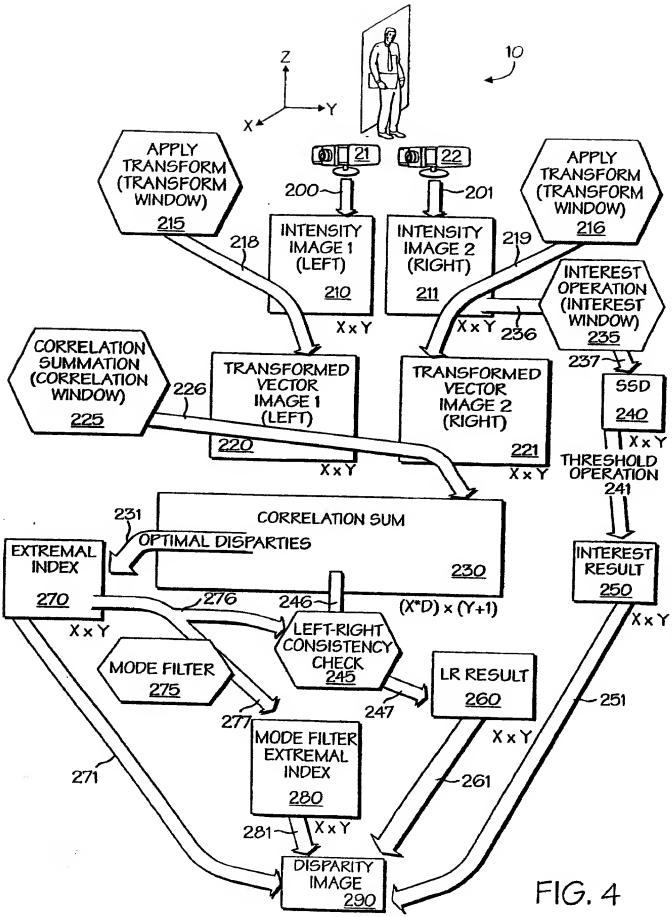


FIG. 4

20120129002001

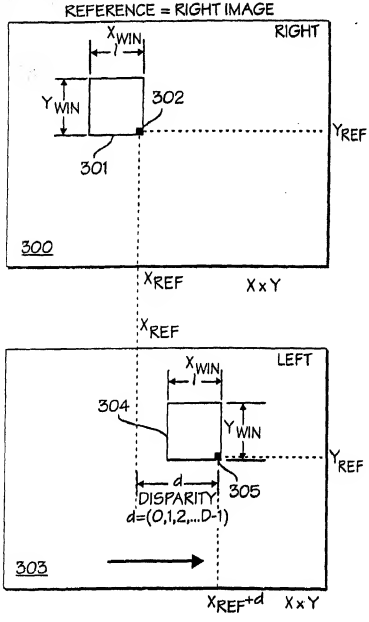


FIG. 5(A)

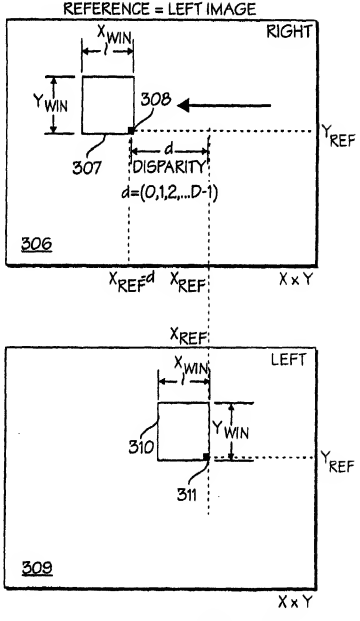


FIG. 5(B)

20:220-29802001

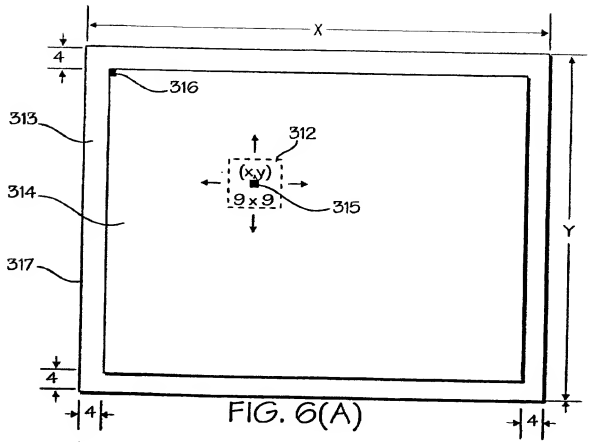


FIG. 6(A)

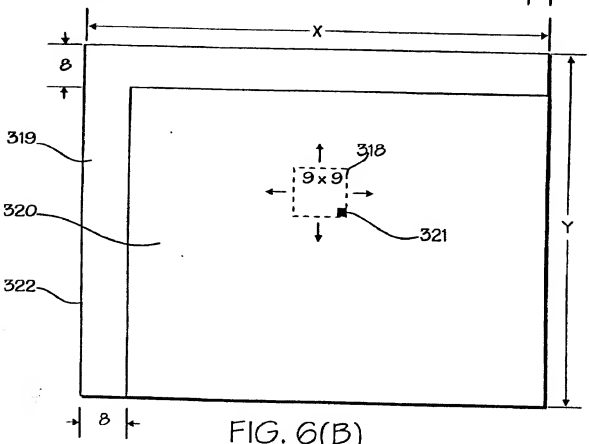


FIG. 6(B)

20120120:259802001

DATA FOR CENSUS VECTOR
CENTERED AT (x,y)

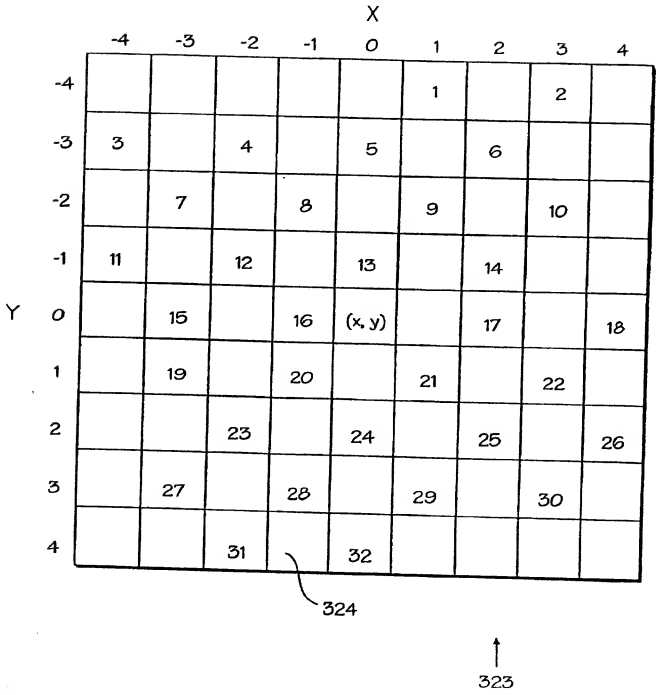


Fig. 7

Fig. 8(A)

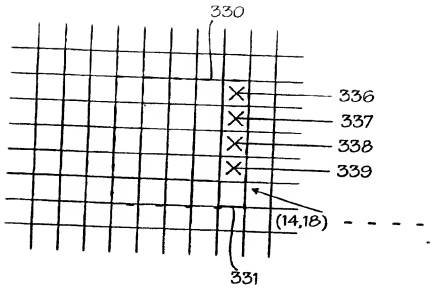


Fig. 8(B)

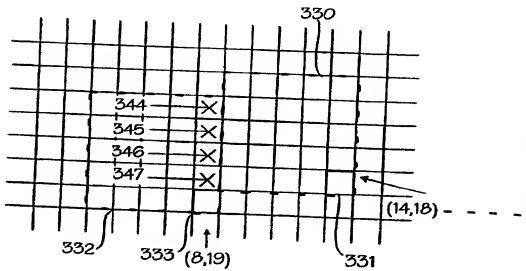
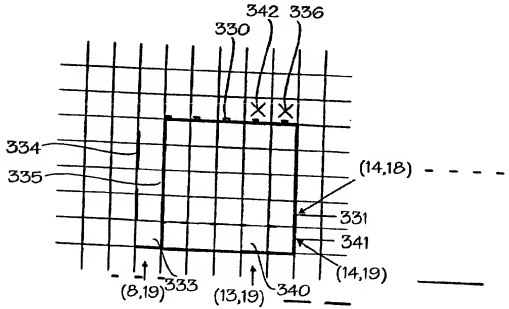


Fig. 8(C)



20120-25802001

Fig. 9(A)

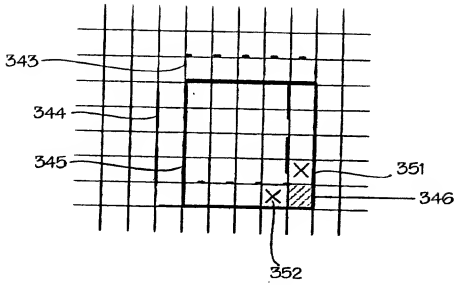


Fig. 9(B)

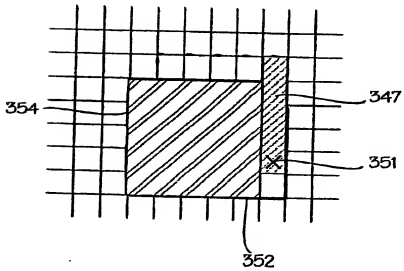
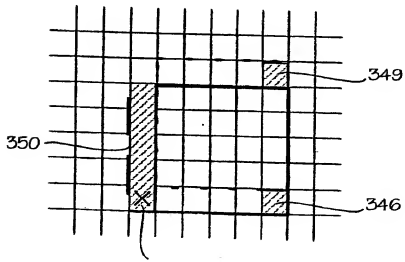


Fig. 9(C)



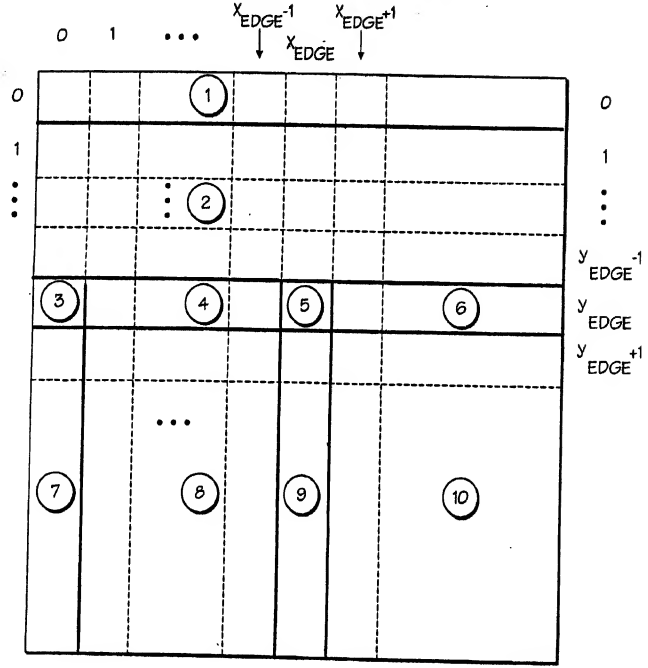


Fig. 10A

20120203-2980200T

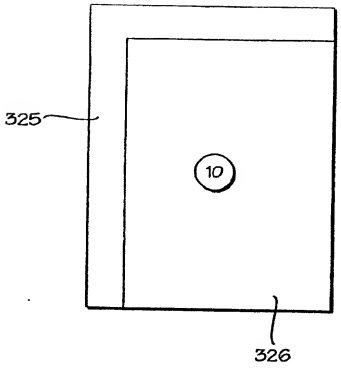


Fig. 10(B)

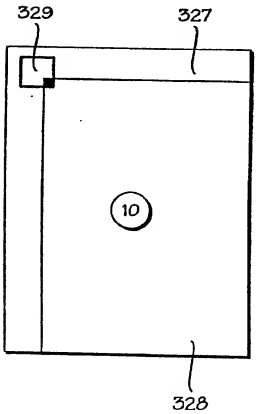


Fig. 10(C)

20120-2980200P1

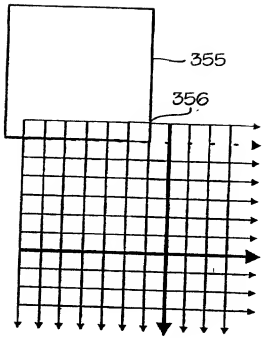


Fig. 11(A)

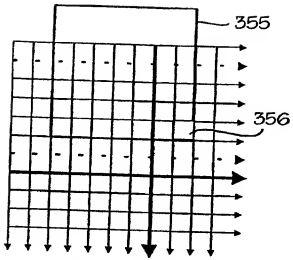


Fig. 11(B)

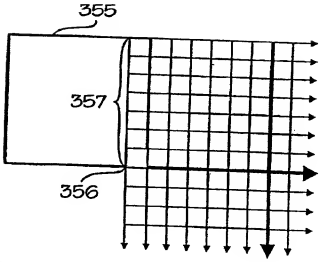


Fig. 11(C)

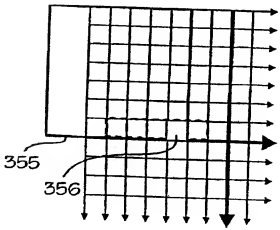


Fig. 11(D)

20120029800A1 - 2012-02-02

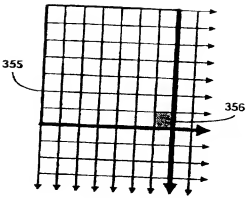


Fig. 11 (E)

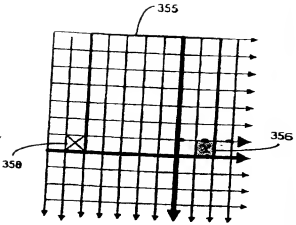


Fig. 11 (F)

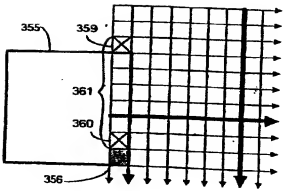


Fig. 11 (G)

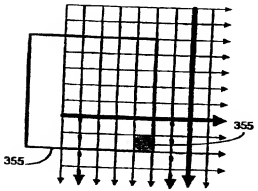


Fig. 11 (H)

2012301-25802011

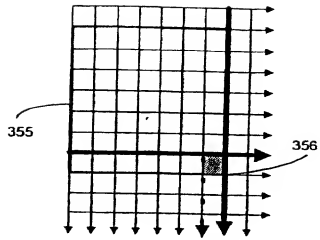


Fig. 11 (I)

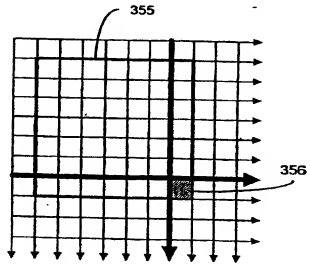


Fig. 11 (J)

20120329-29802011

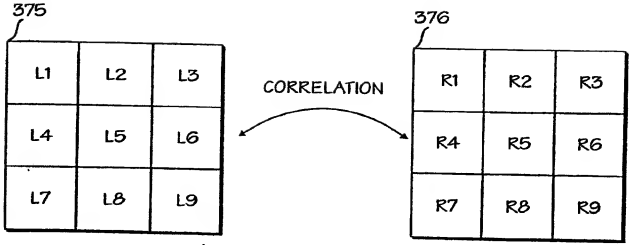


Fig. 12

20120802 "29802001

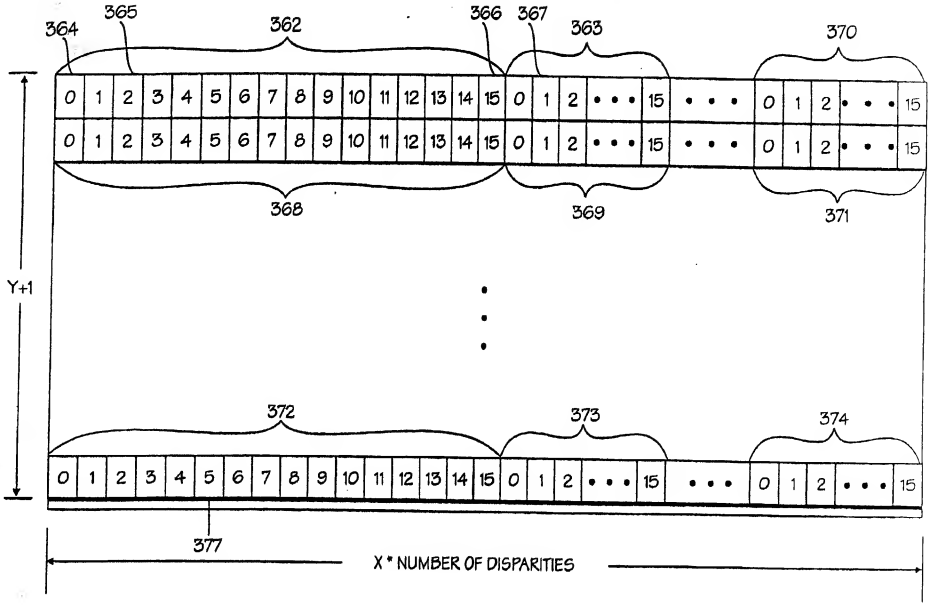
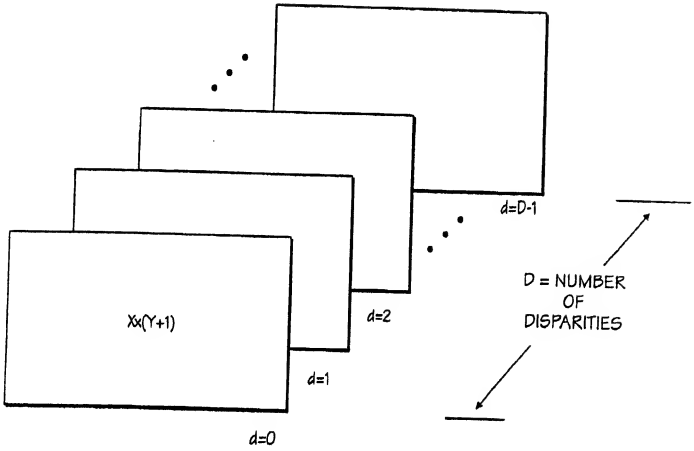


Fig. 13A

20120229802001



(B)

Fig. 13B

20232-2680201 100208622-032102

FIG. 14(A)

FIG. 14(B)

FIG. 14(C)

FIG. 14(D)

EP 0 732 659 A2

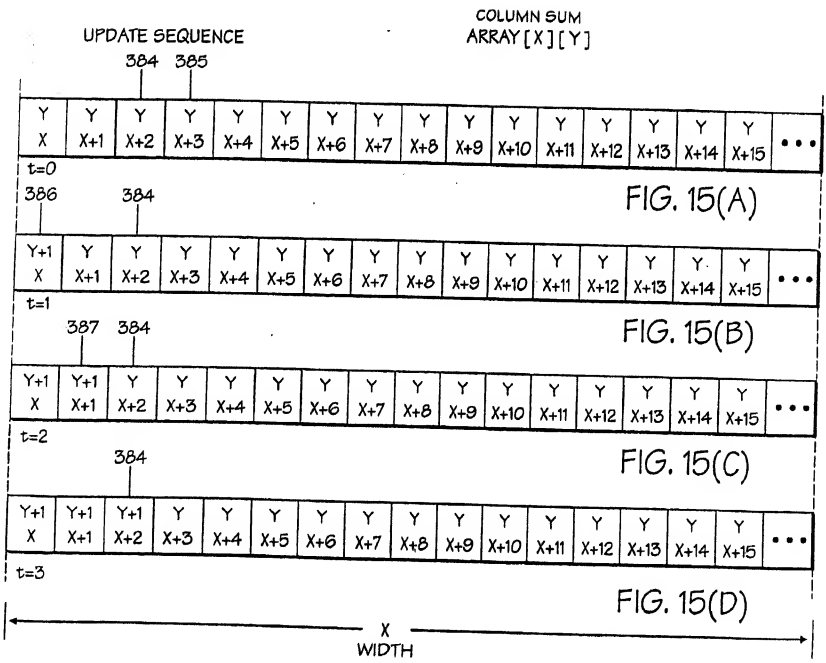


FIG. 15(A)

FIG. 15(B)

FIG. 15(C)

FIG. 15(D)

1002086 .032102

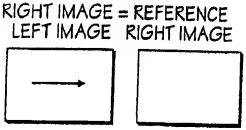


Fig. 16A Fig. 16B

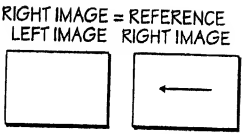


Fig. 16C Fig. 16D

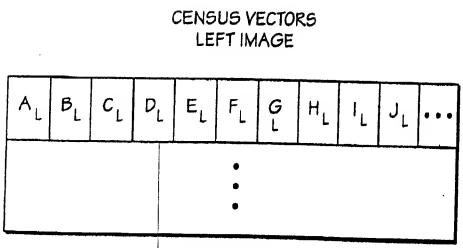


Fig. 16E

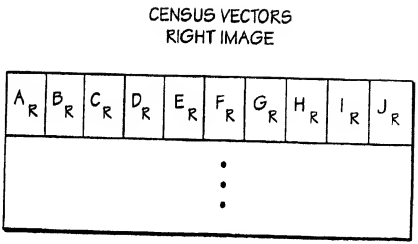


Fig. 16F

20120829029802001

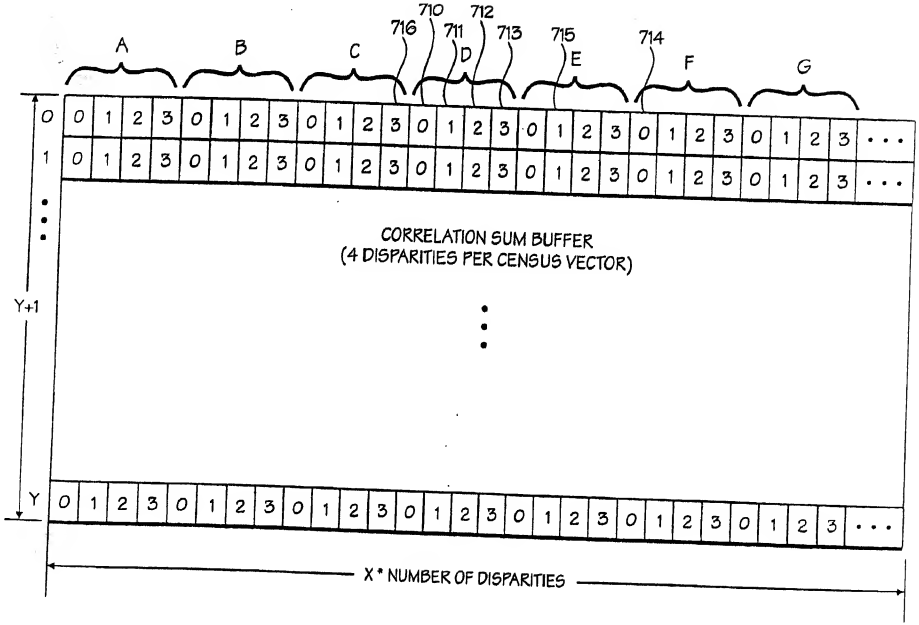


Fig. 16G

20120-29802001

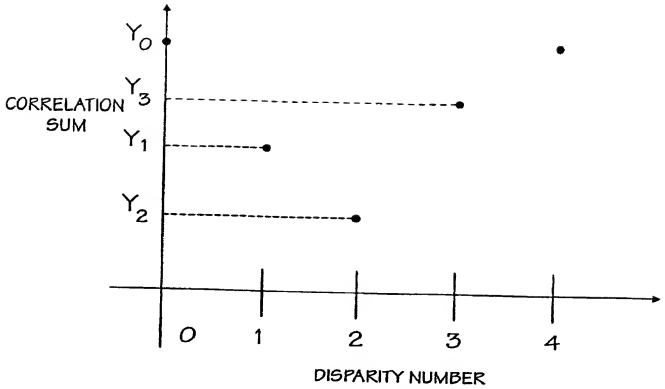


FIG. 17(A)

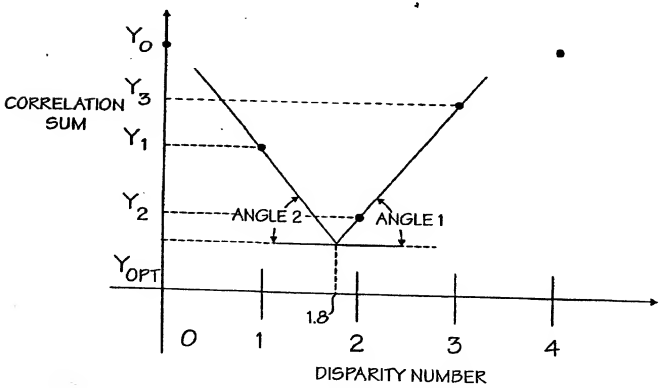


FIG. 17(B)

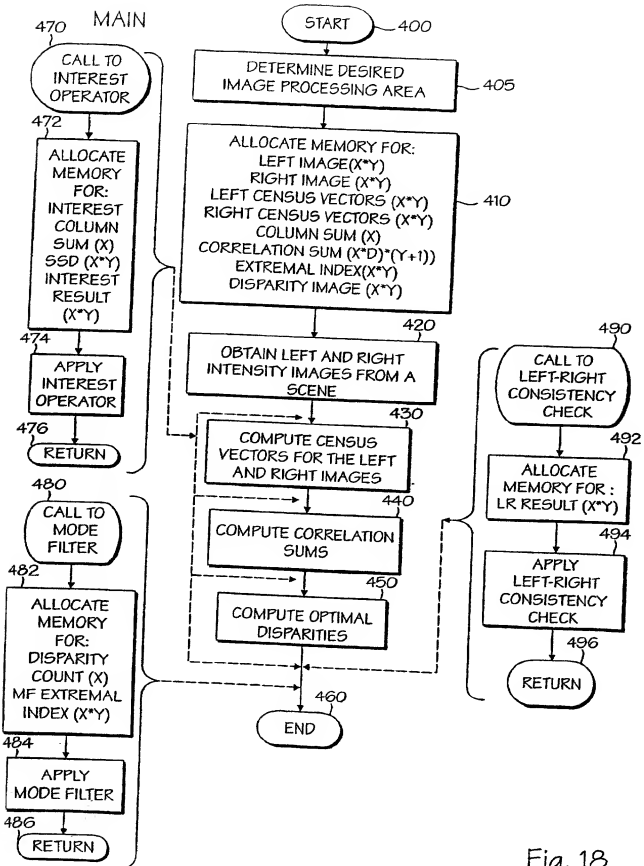

MAIN
470
CALL TO INTEREST OPERATOR
472
ALLOCATE MEMORY FOR: INTEREST COLUMN SUM (X) SSD (X*Y) INTEREST RESULT (X*Y)
474
APPLY INTEREST OPERATOR
476
RETURN
480
CALL TO MODE FILTER
482
ALLOCATE MEMORY FOR: DISPARITY COUNT (X) MF EXTREMAL INDEX (X*Y)
484
APPLY MODE FILTER
486
RETURN
START
400
DETERMINE DESIRED IMAGE PROCESSING AREA
405
ALLOCATE MEMORY FOR: LEFT IMAGE(X*Y) RIGHT IMAGE (X*Y) LEFT CENSUS VECTORS (X*Y) RIGHT CENSUS VECTORS (X*Y) COLUMN SUM (X) CORRELATION SUM (X*D)*(Y+1)) EXTREMAL INDEX(X*Y) DISPARITY IMAGE (X*Y)
410
420
OBTAIN LEFT AND RIGHT INTENSITY IMAGES FROM A SCENE
430
COMPUTE CENSUS VECTORS FOR THE LEFT AND RIGHT IMAGES
440
COMPUTE CORRELATION SUMS
450
COMPUTE OPTIMAL DISPARITIES
460
END
490
CALL TO LEFT-RIGHT CONSISTENCY CHECK
492
ALLOCATE MEMORY FOR : LR RESULT (X*Y)
494
APPLY LEFT-RIGHT CONSISTENCY CHECK
496
RETURN

Fig. 18

20120: 2980201

CENSUS TRANSFORM
&
CENSUS VECTORS

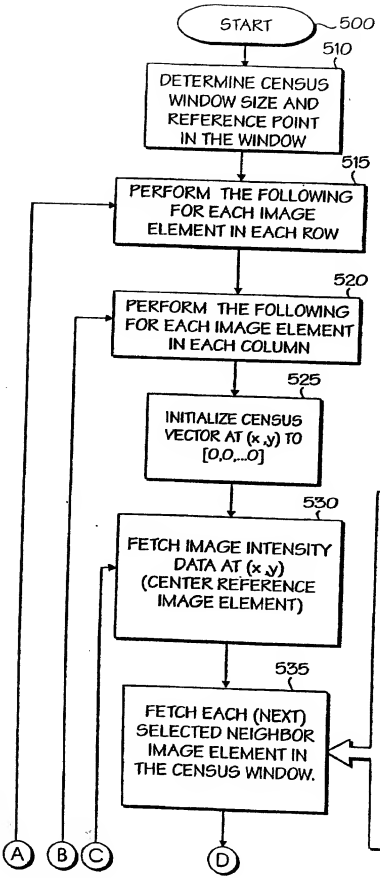


Fig. 19(A)

20120230-2980200001

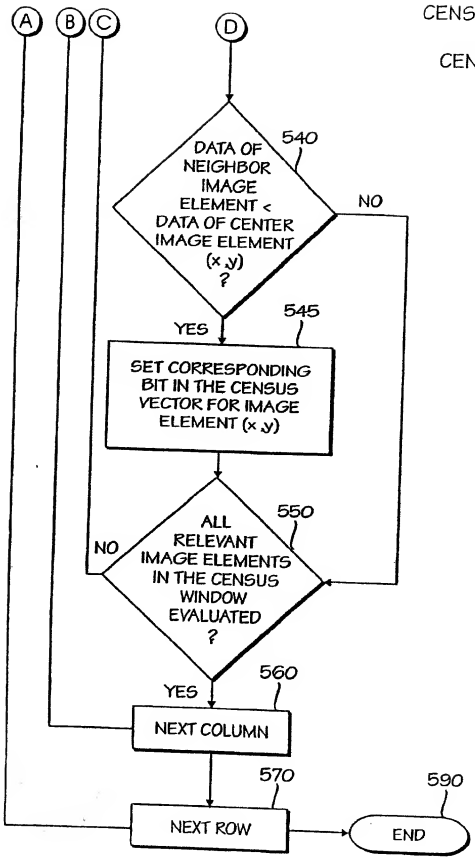


Fig. 19(B)

2012230-2580210T

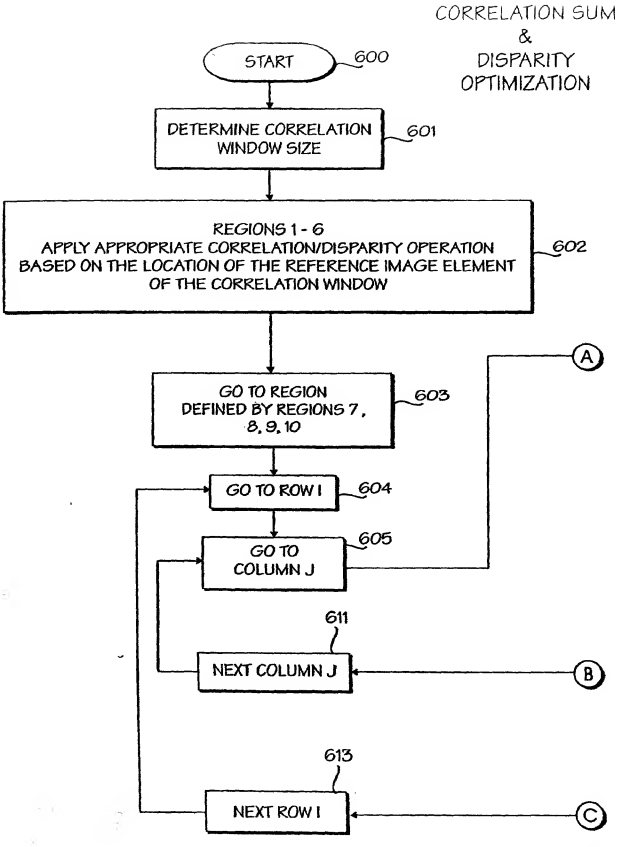


Fig. 20(A)

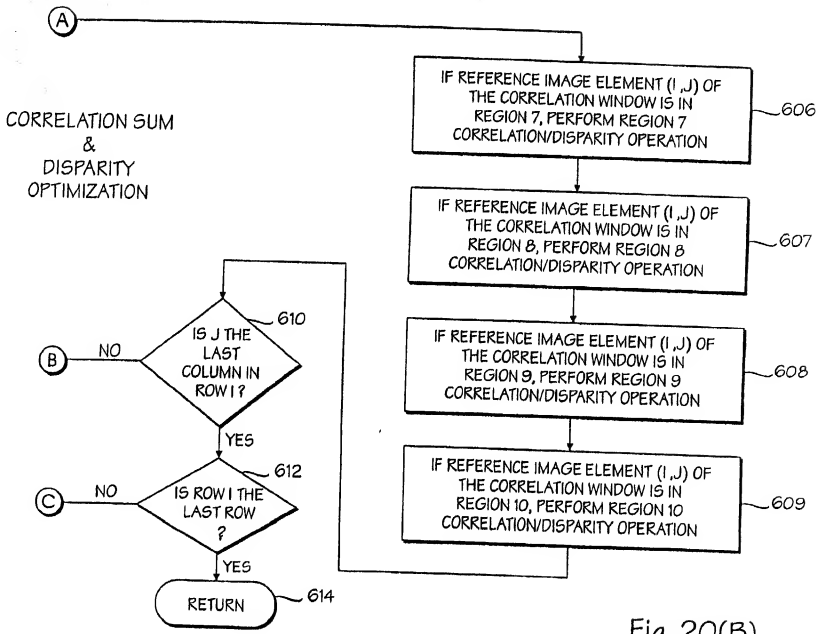

A
CORRELATION SUM & DISPARITY OPTIMIZATION
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 7, PERFORM REGION 7 CORRELATION/DISPARITY OPERATION
606
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 8, PERFORM REGION 8 CORRELATION/DISPARITY OPERATION
607
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 9, PERFORM REGION 9 CORRELATION/DISPARITY OPERATION
608
IF REFERENCE IMAGE ELEMENT (I ,J) OF THE CORRELATION WINDOW IS IN REGION 10, PERFORM REGION 10 CORRELATION/DISPARITY OPERATION
609
IS J THE LAST COLUMN IN ROW I ?
610
B
NO
YES
IS ROW I THE LAST ROW ?
612
C
NO
YES
RETURN
614

Fig. 20(B)

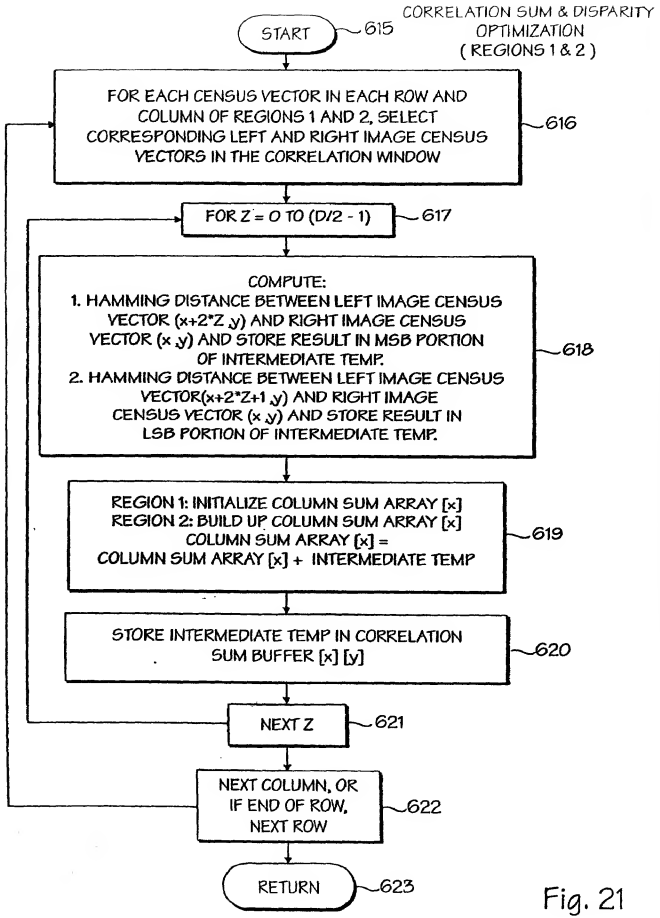


Fig. 21

10020080 - 032102

20120025980A1

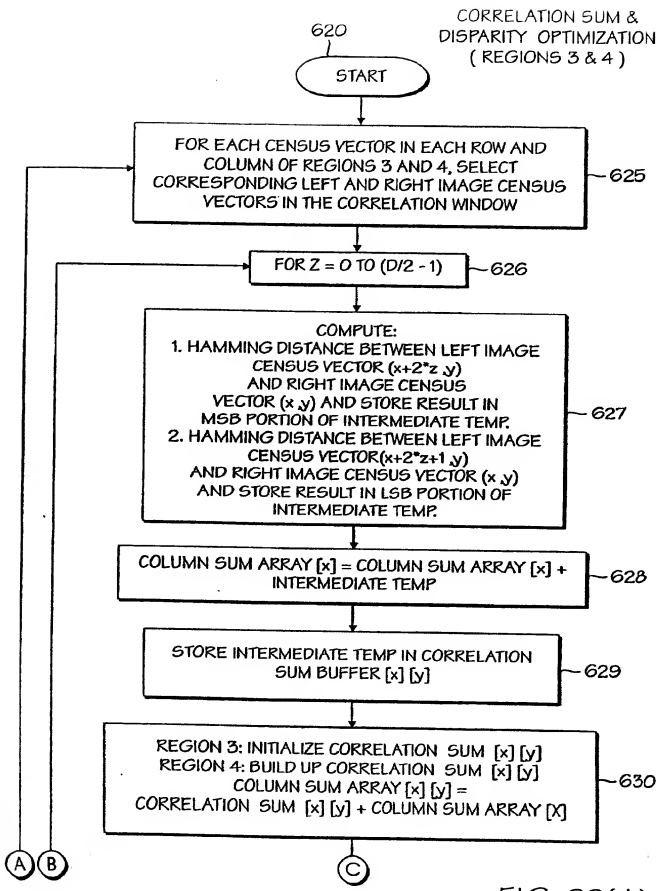


FIG. 22(A)

20120302 2580001

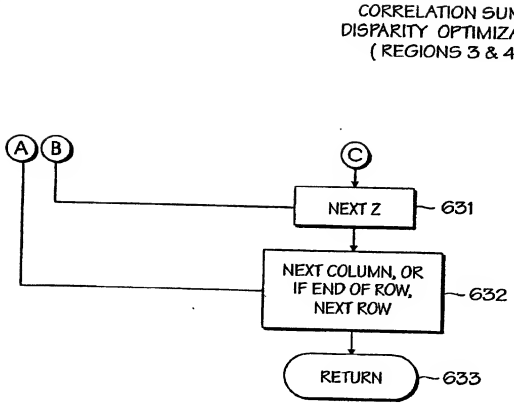


FIG. 22(B)

20120230-2980200101

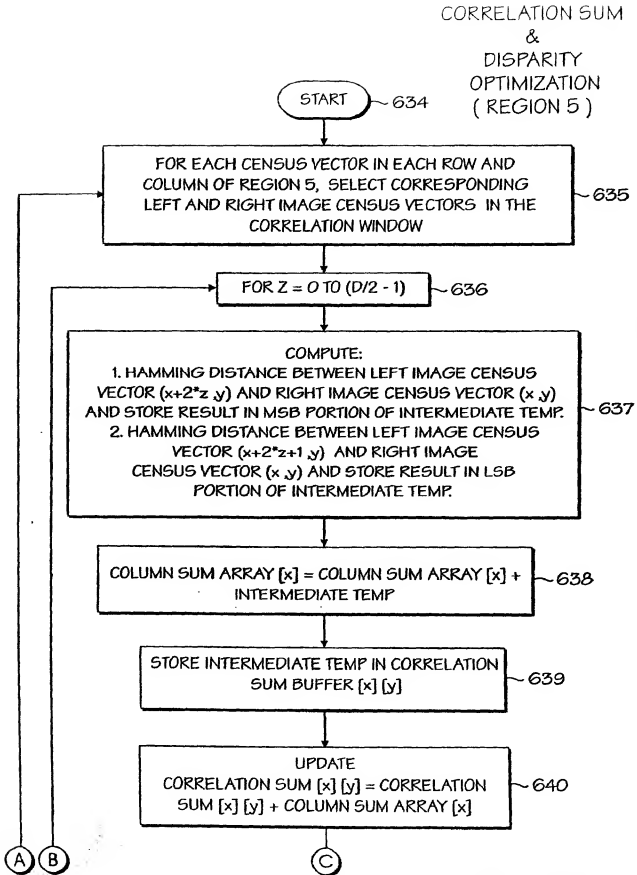


FIG. 23(A)

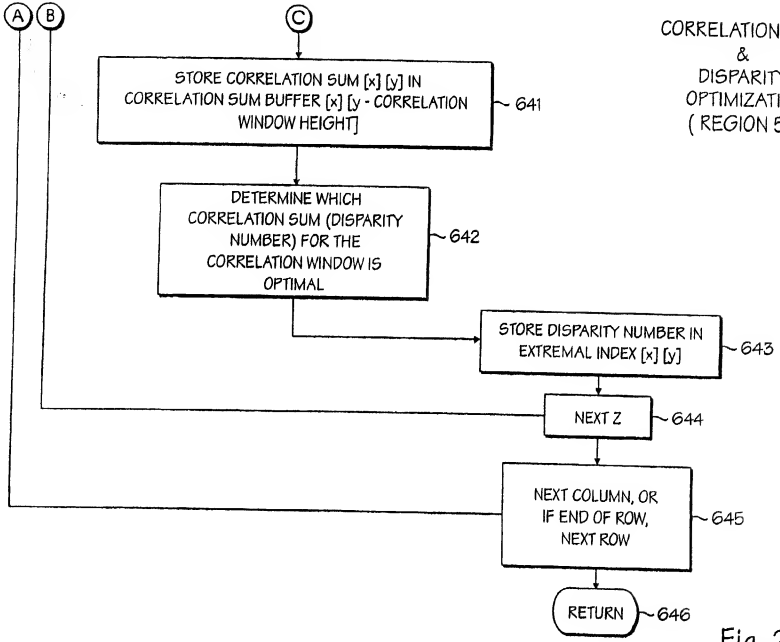

A
B
C
CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGION 5)
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y - CORRELATION WINDOW HEIGHT]
641
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
642
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
643
NEXT Z
644
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
645
RETURN
646

Fig. 23(B)

20120210 29802011

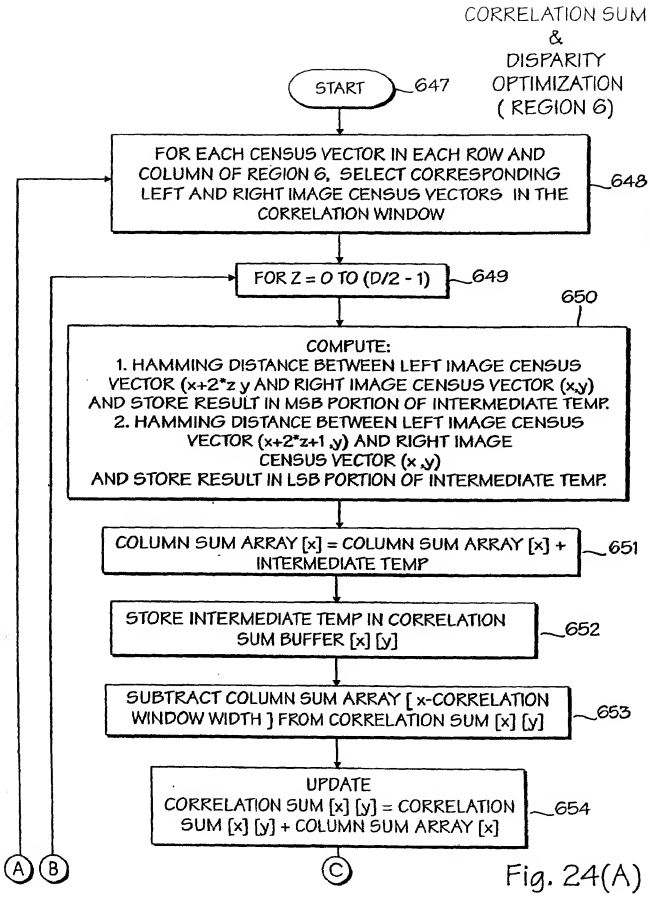


Fig. 24(A)

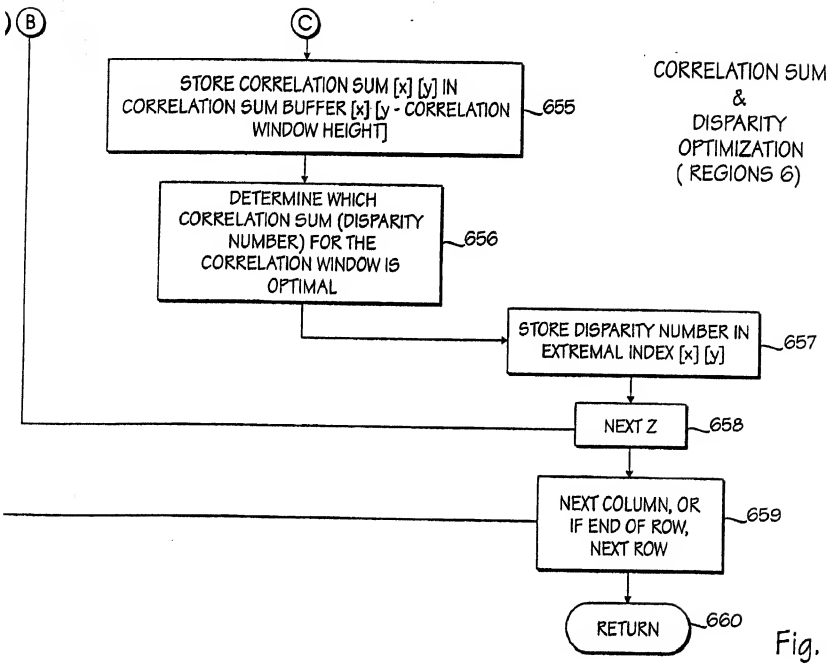

B
C
STORE CORRELATION SUM [x] [y] IN CORRELATION SUM BUFFER [x] [y - CORRELATION WINDOW HEIGHT]
655
DETERMINE WHICH CORRELATION SUM (DISPARITY NUMBER) FOR THE CORRELATION WINDOW IS OPTIMAL
656
STORE DISPARITY NUMBER IN EXTREMAL INDEX [x] [y]
657
NEXT Z
658
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
659
RETURN
660
CORRELATION SUM & DISPARITY OPTIMIZATION (REGIONS 6)

Fig. 24(B)

20120128.0220.0002001

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGIONS 7 & 8)

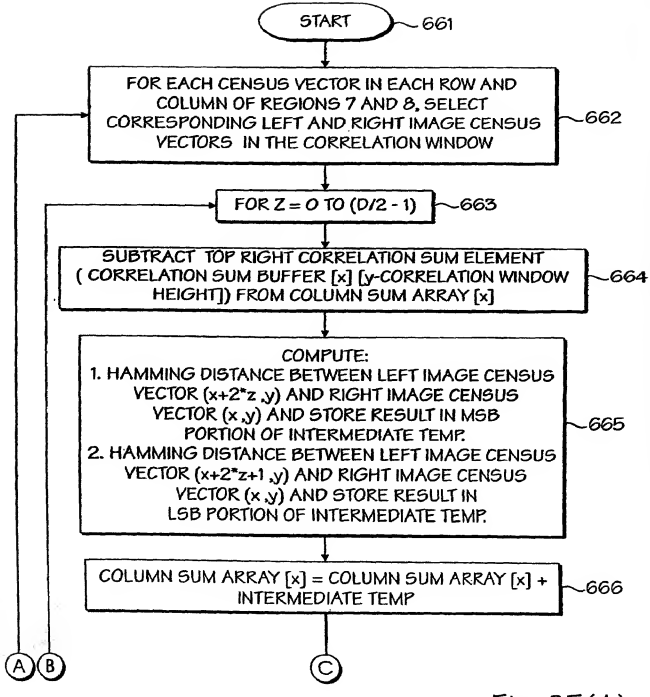


Fig. 25(A)

20120210-2980200T

CORRELATION SUM
&
DISPARITY
OPTIMIZATION
(REGIONS 7 & 8)

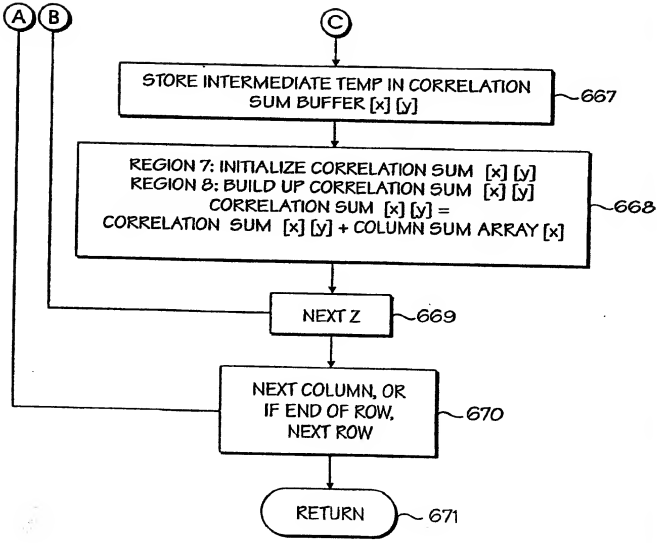


Fig. 25(B)

20020080021102

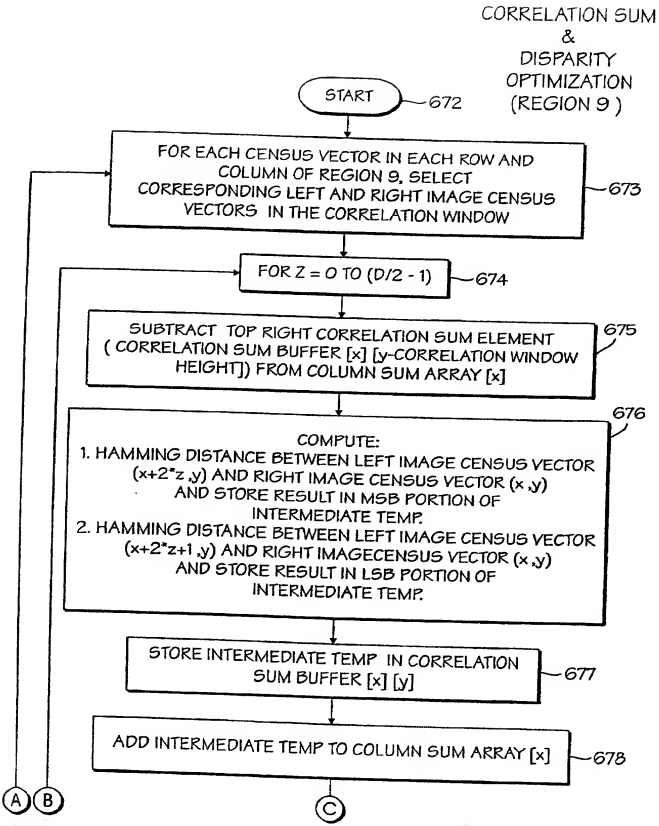


FIG. 26(A)

20120-29802001

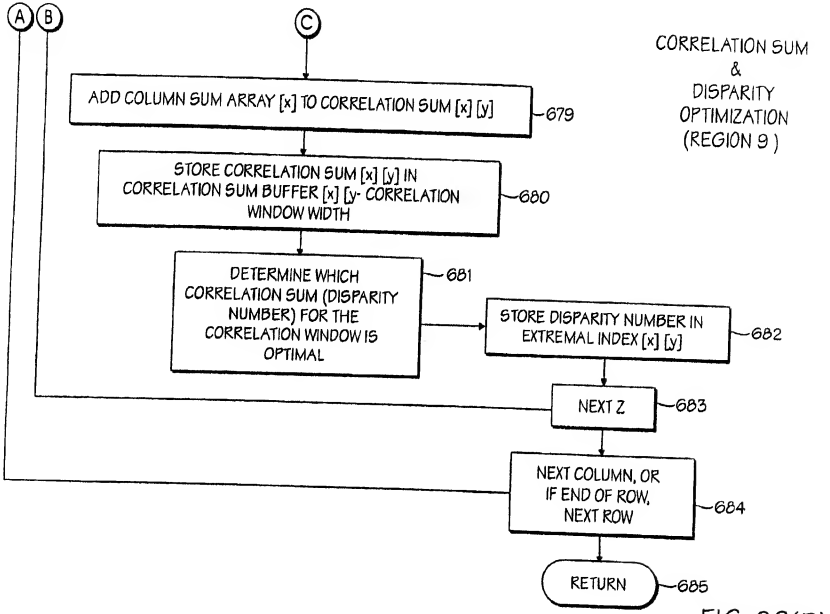


FIG. 26(B)

20120-2980201

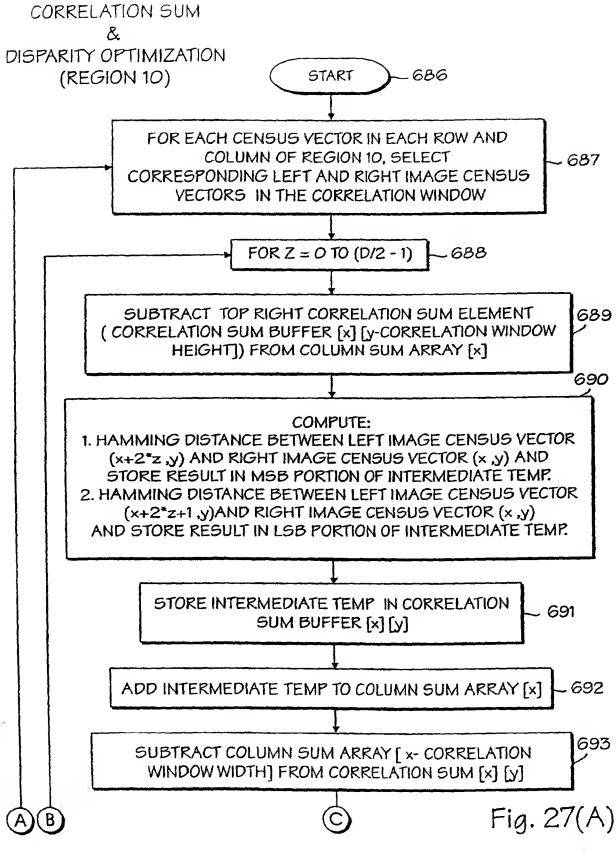


Fig. 27(A)

20120029802001

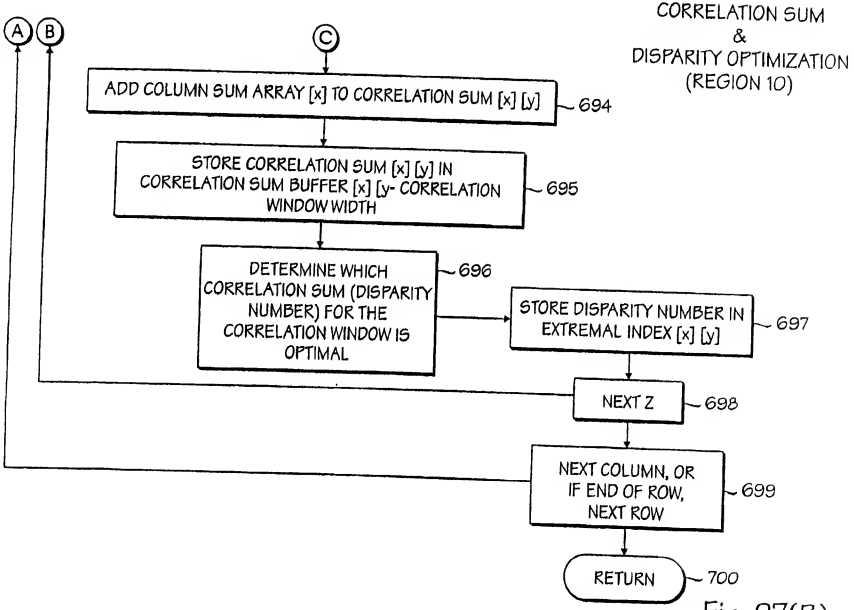


Fig. 27(B)

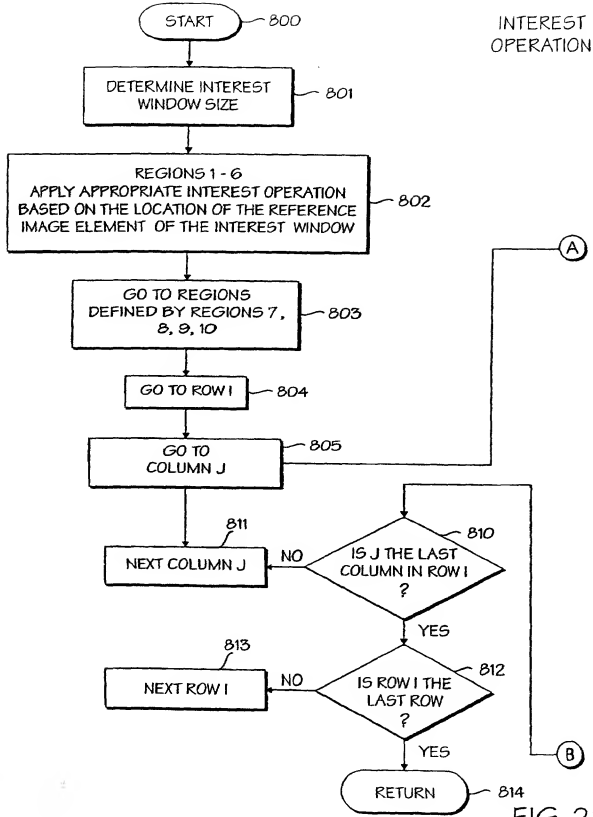


FIG. 28(A)

10025250 - 2502102

20120210-2930200A

INTEREST
OPERATION

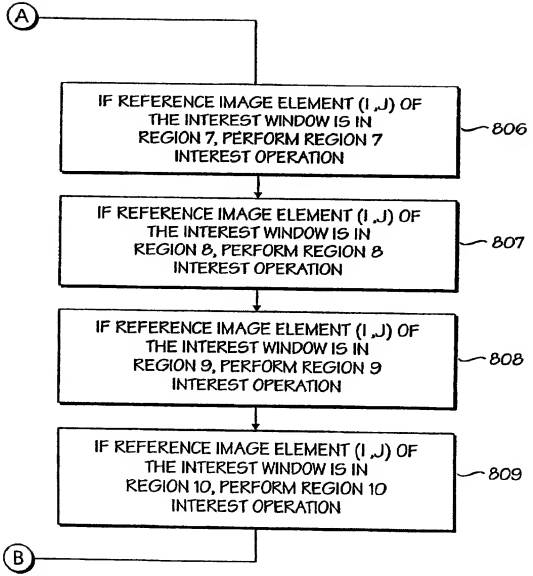


FIG. 28(B)

10020865-032102

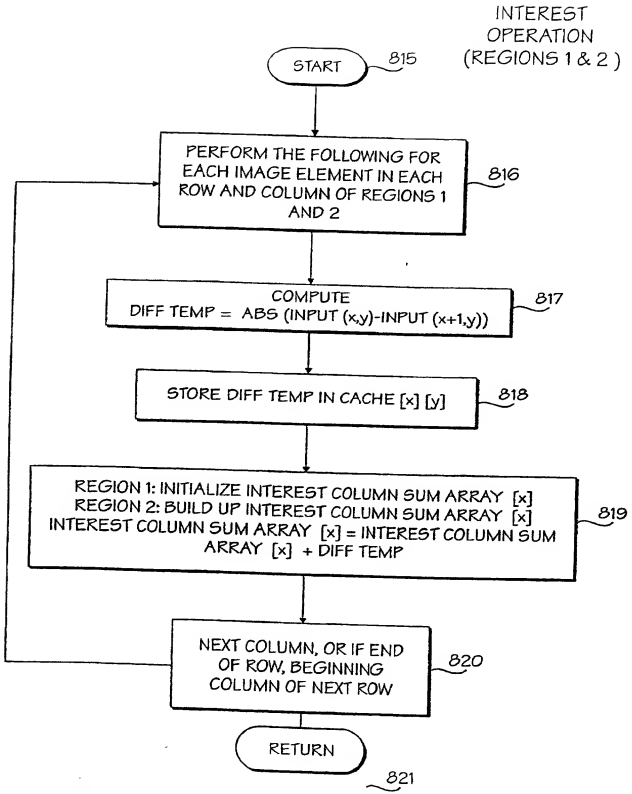


FIG. 29

20120229802001

FIG. 3C

20120085-033102

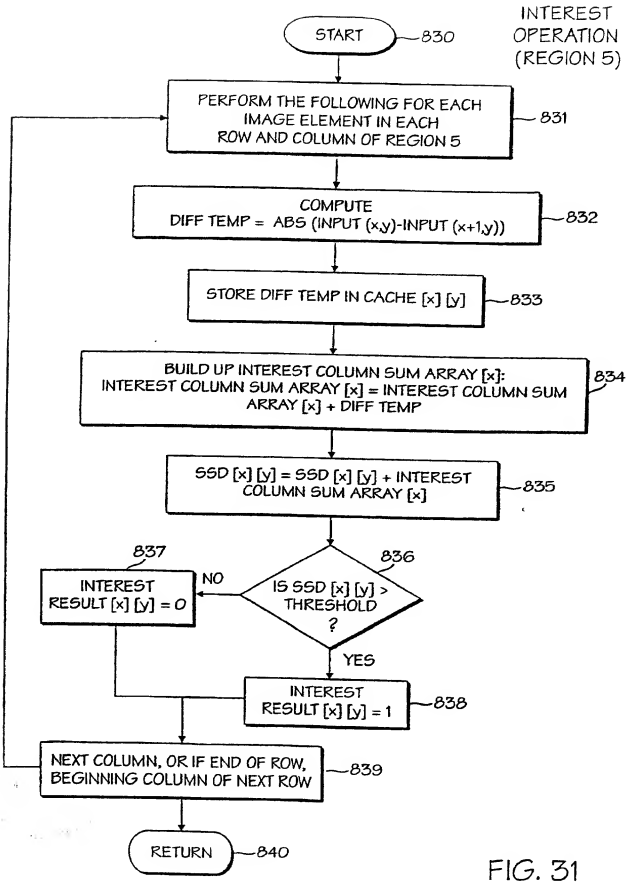


FIG. 31

20120029802001

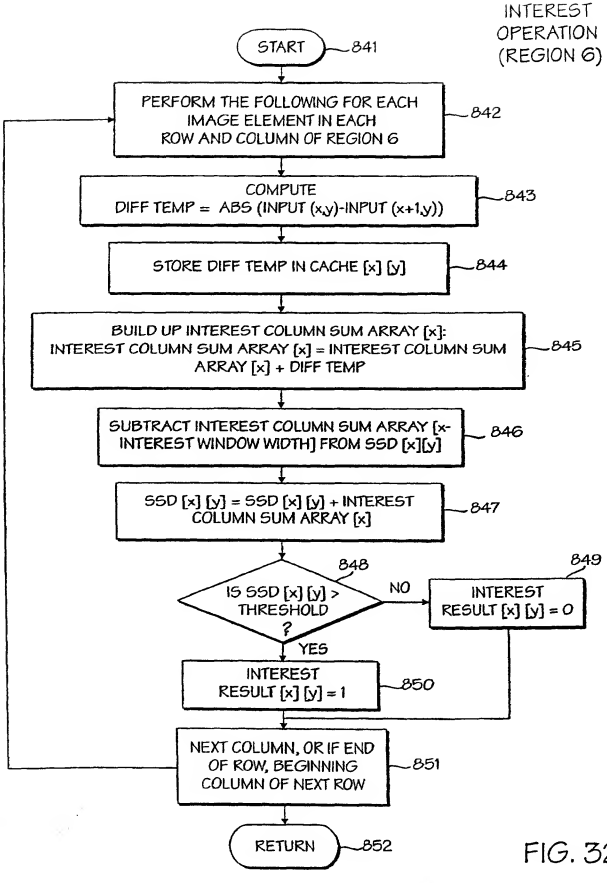


FIG. 32

20120: 2580200T

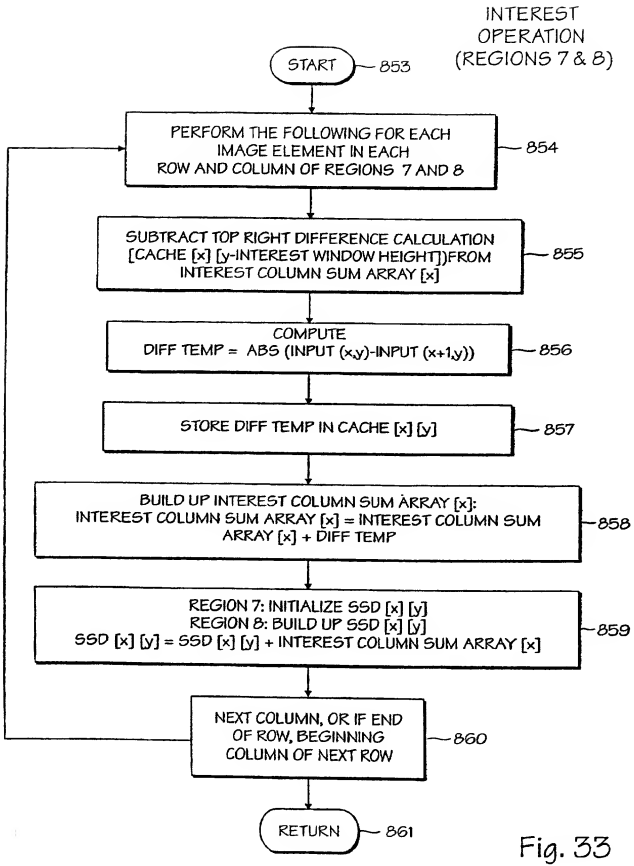


Fig. 33

20120-2500200.1

INTEREST OPERATION (REGION 9)

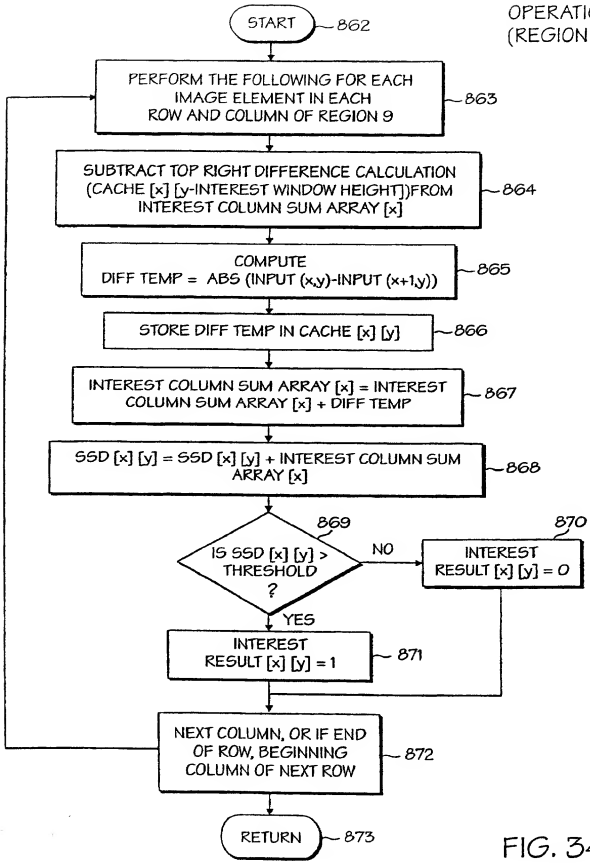


FIG. 34

20120306-0022102

INTEREST
OPERATION
(REGION 10)

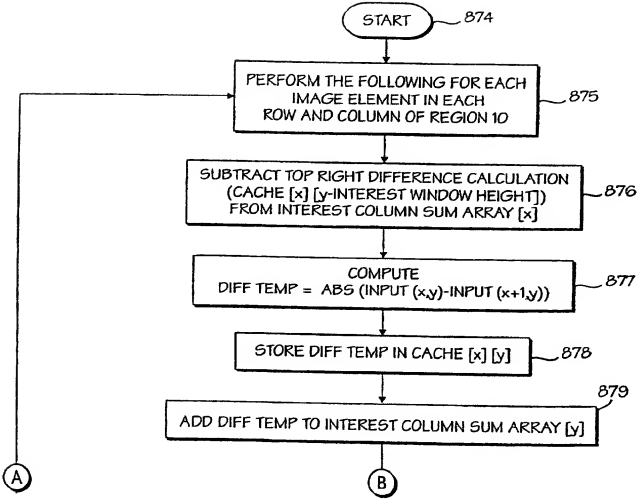


Fig. 35(A)

20120258020A1

INTEREST
OPERATION
(REGION 10)

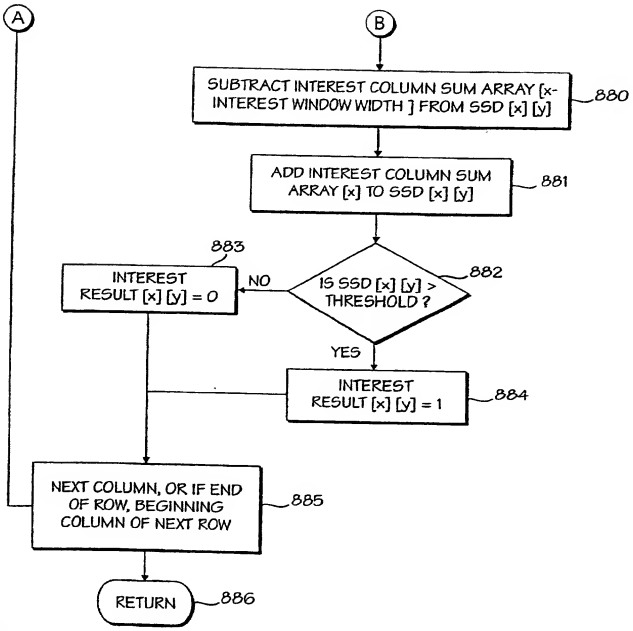


Fig. 35(B)

20120-2980200

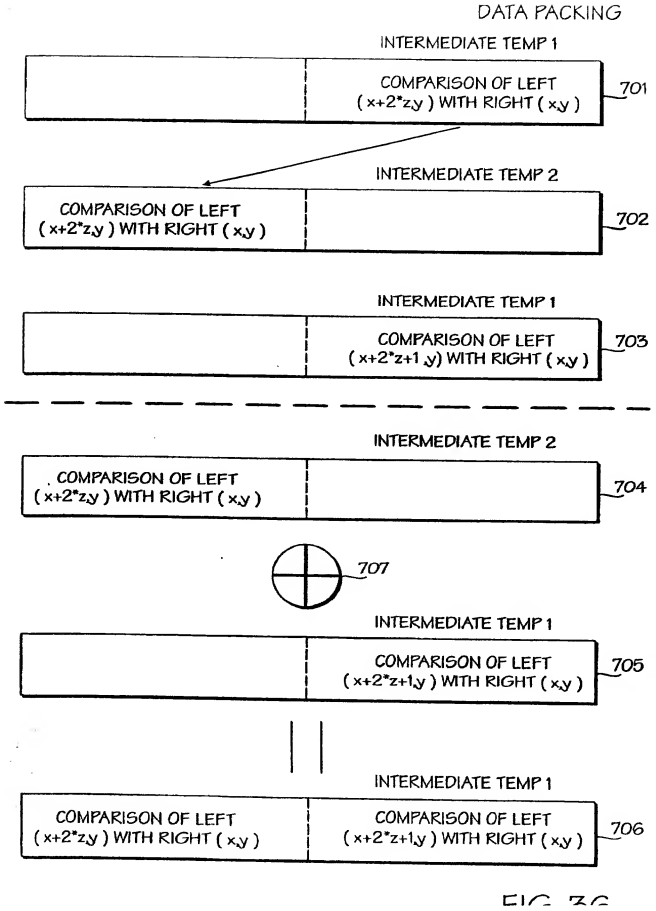


FIG. 3G

20120302502001

LEFT - RIGHT
CONSISTENCY
CHECK

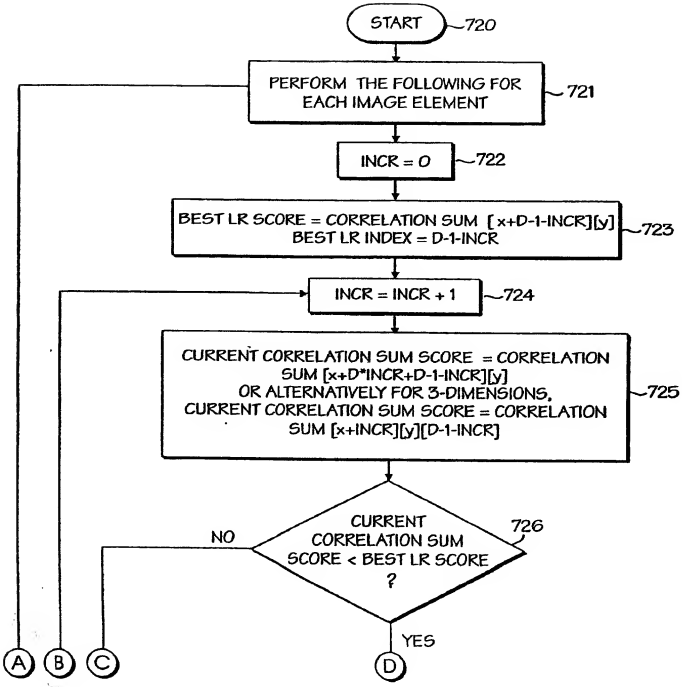
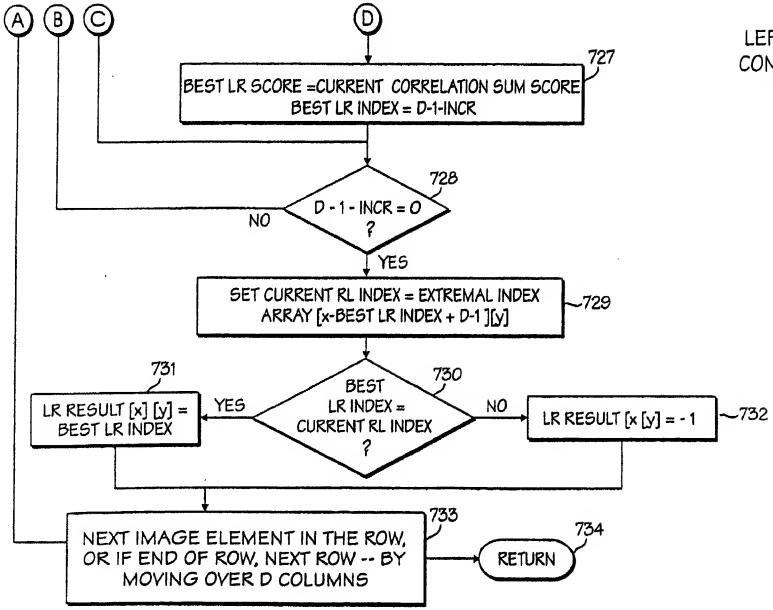


FIG. 37(A)



LEFT - RIGHT CONSISTENCY CHECK

FIG. 37(B)

20120-2980200T

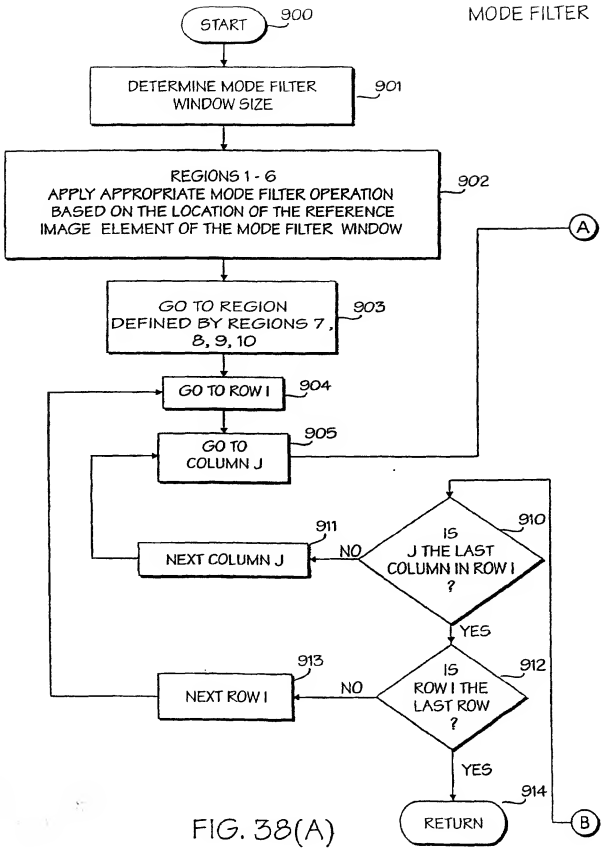


FIG. 38(A)

20120325002001

MODE FILTER

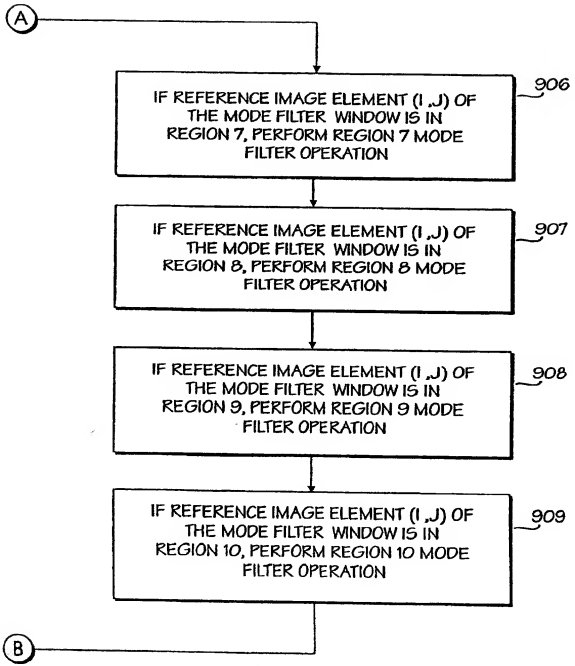


FIG. 38(B)

20120852.032102

MODE FILTER
(REGIONS 1 & 2)

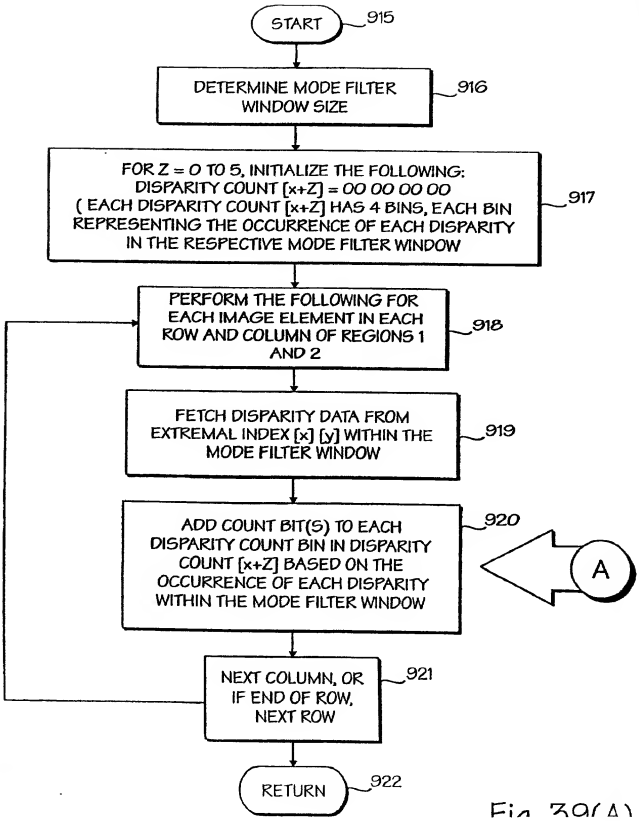


Fig. 39(A)

MODE FILTER
(REGIONS 1 & 2)

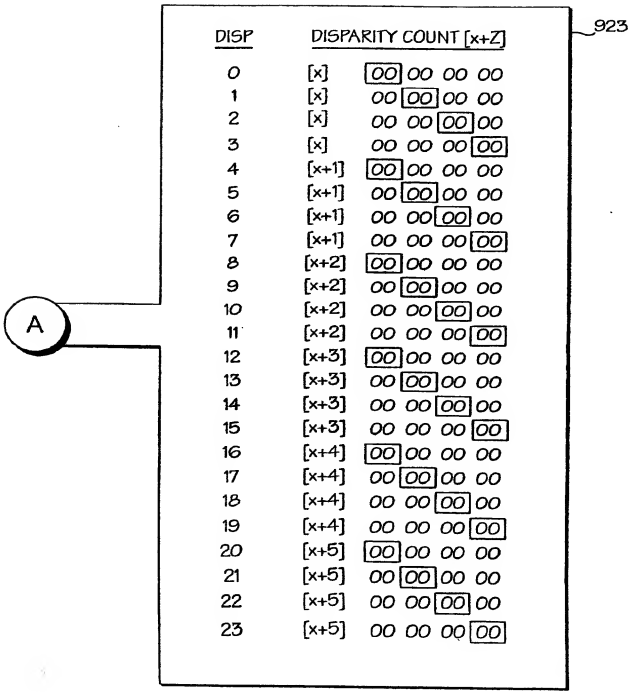
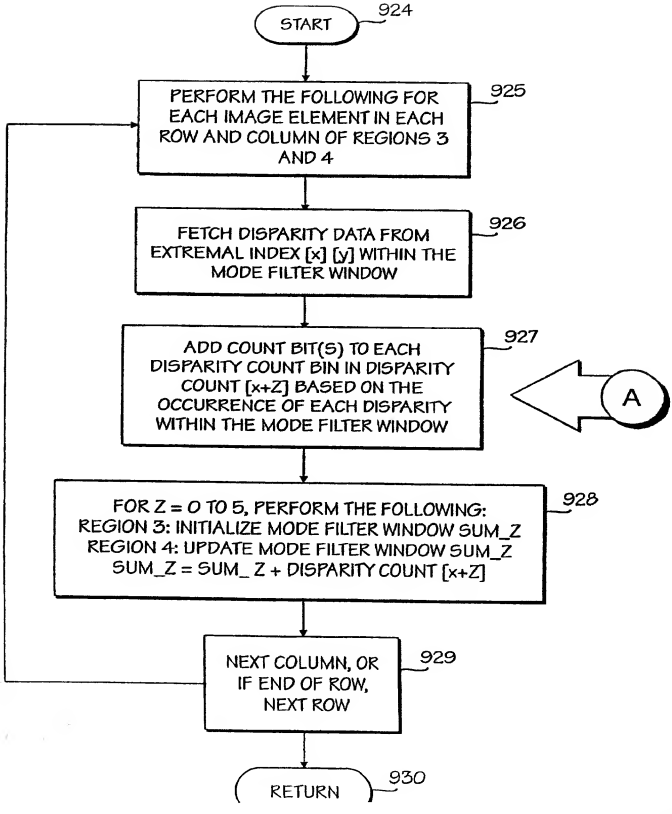


Fig 39(B)

20120130:2980200T

MODE FILTER
(REGIONS 3 & 4)



20120-25802001

MODE FILTER
(REGIONS 3 & 4)

931

DISP	DISPARITY COUNT [x+Z]
0	[x] [00] 00 00 00
1	[x] 00 [00] 00 00
2	[x] 00 00 [00] 00
3	[x] 00 00 00 [00]
4	[x+1] [00] 00 00 00
5	[x+1] 00 [00] 00 00
6	[x+1] 00 00 [00] 00
7	[x+1] 00 00 00 [00]
8	[x+2] [00] 00 00 00
9	[x+2] 00 [00] 00 00
10	[x+2] 00 00 [00] 00
11	[x+2] 00 00 00 [00]
12	[x+3] [00] 00 00 00
13	[x+3] 00 [00] 00 00
14	[x+3] 00 00 [00] 00
15	[x+3] 00 00 00 [00]
16	[x+4] [00] 00 00 00
17	[x+4] 00 [00] 00 00
18	[x+4] 00 00 [00] 00
19	[x+4] 00 00 00 [00]
20	[x+5] [00] 00 00 00
21	[x+5] 00 [00] 00 00
22	[x+5] 00 00 [00] 00
23	[x+5] 00 00 00 [00]

A

FIG 40(B)

US 2012/0027286 A1 Feb. 2, 2012

MODE FILTER
(REGION 5)

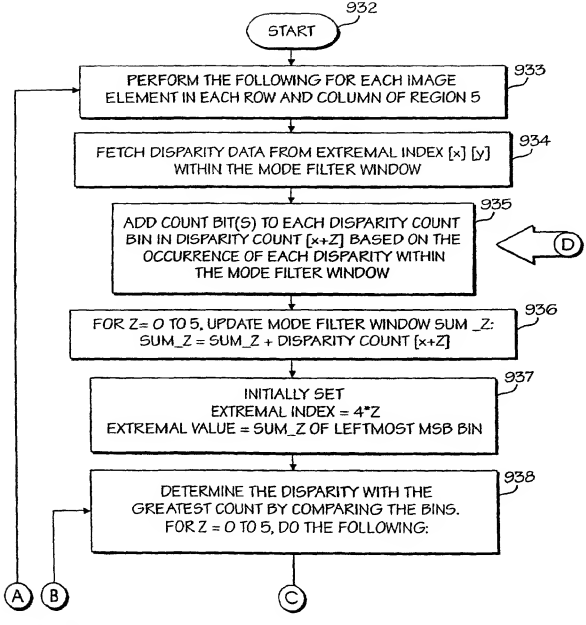


FIG. 41(A)

20120230-29802001

MODE FILTER
(REGION 5)

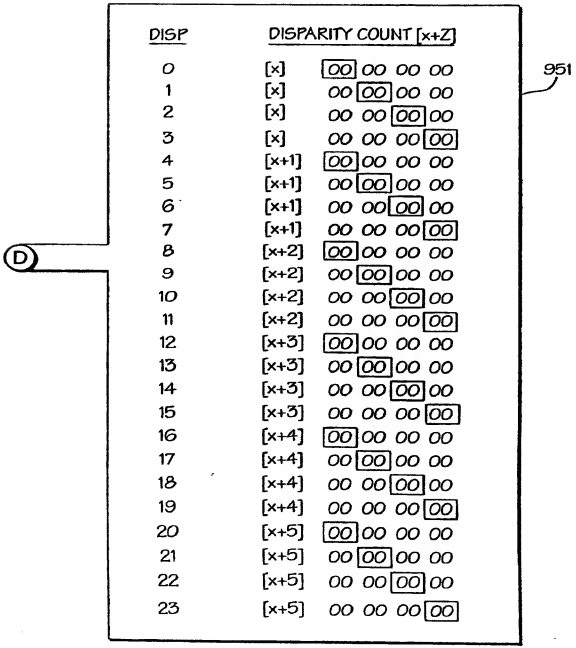


FIG. 41(B)

20120130-2538020U1

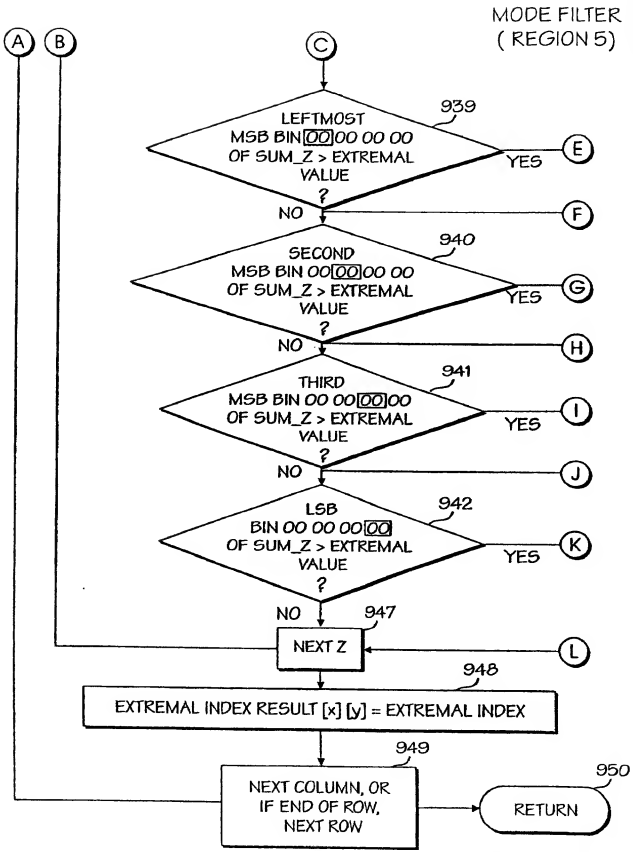


FIG. 41(C)

20120238201

MODE FILTER
(REGION 5)

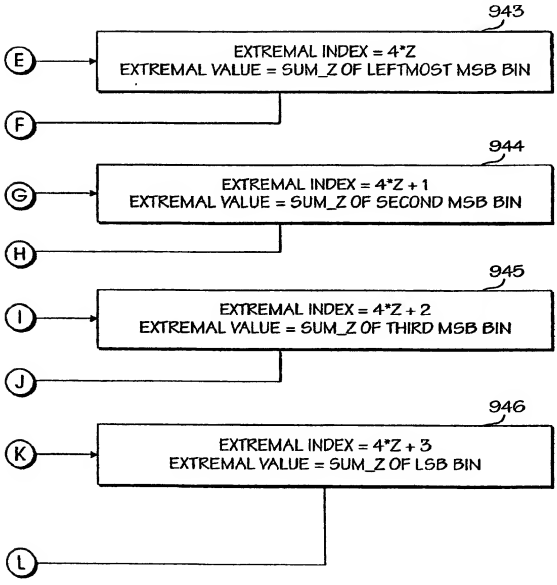


FIG. 41(D)

20120302-2980200T

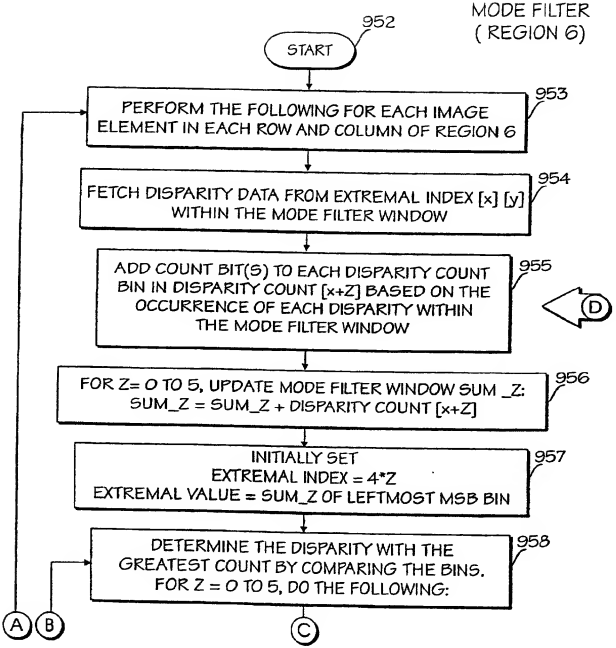


FIG. 42(A)

MODE FILTER
(REGION 6)

DISP	DISPARITY COUNT [x+Z]	
0	[x]	[00] 00 00 00
1	[x]	00 [00] 00 00
2	[x]	00 00 [00] 00
3	[x]	00 00 00 [00]
4	[x+1]	[00] 00 00 00
5	[x+1]	00 [00] 00 00
6	[x+1]	00 00 [00] 00
7	[x+1]	00 00 00 [00]
8	[x+2]	[00] 00 00 00
9	[x+2]	00 [00] 00 00
10	[x+2]	00 00 [00] 00
11	[x+2]	00 00 00 [00]
12	[x+3]	[00] 00 00 00
13	[x+3]	00 [00] 00 00
14	[x+3]	00 00 [00] 00
15	[x+3]	00 00 00 [00]
16	[x+4]	[00] 00 00 00
17	[x+4]	00 [00] 00 00
18	[x+4]	00 00 [00] 00
19	[x+4]	00 00 00 [00]
20	[x+5]	[00] 00 00 00
21	[x+5]	00 [00] 00 00
22	[x+5]	00 00 [00] 00
23	[x+5]	00 00 00 [00]

971

D

FIG. 42(B)

20120255802001.02312001

20220-0022001

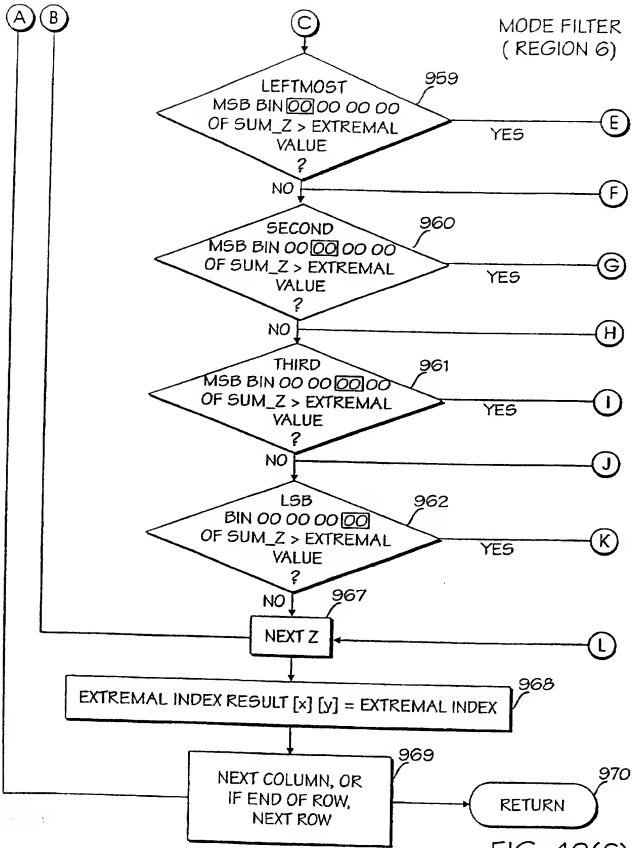


FIG. 42(C)

20120209802001

MODE FILTER
(REGION 6)

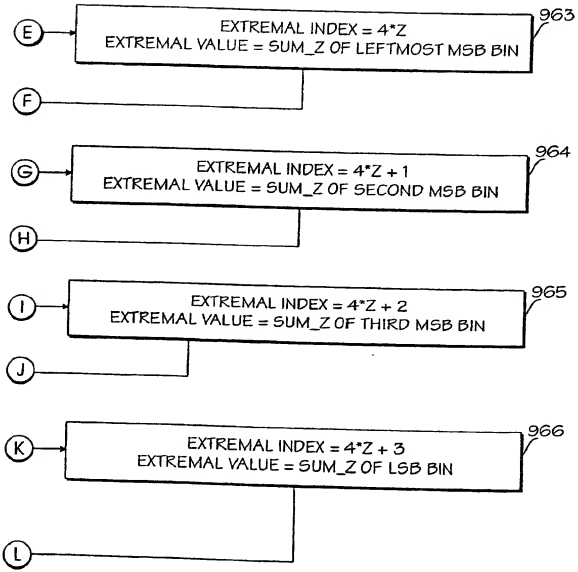


FIG. 42(D)

20120-2980001

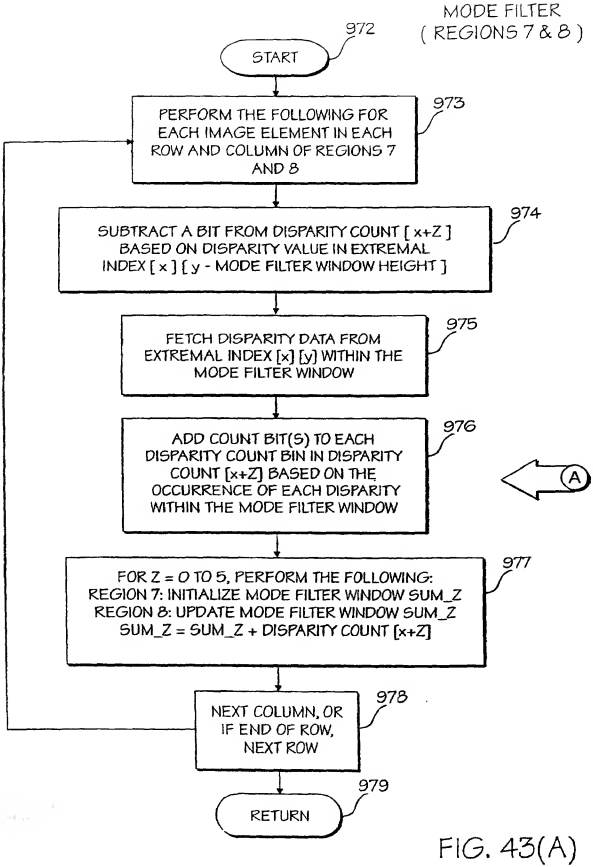


FIG. 43(A)

MODE FILTER
(REGIONS 7 & 8)

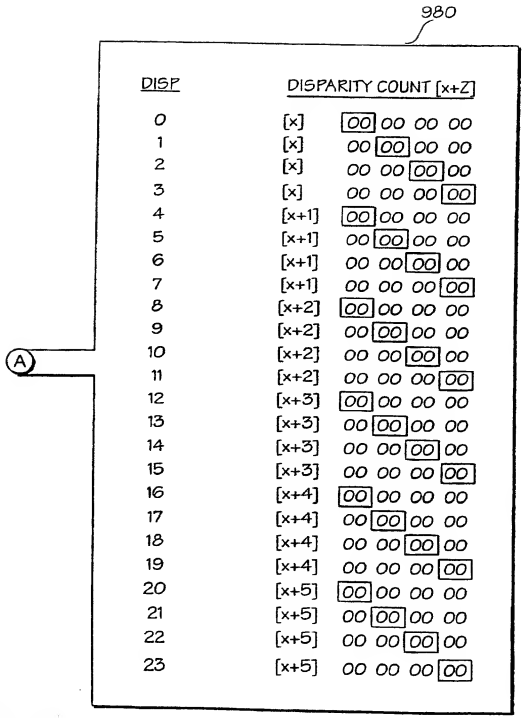


FIG. 43(B)

20120250880 - 2012-10-04

20120-2980001

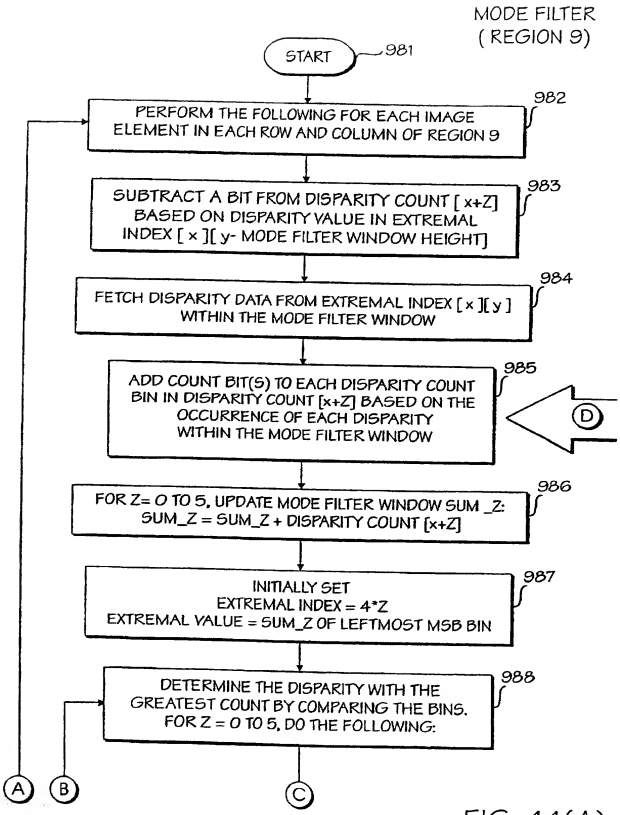


FIG. 44(A)

MODE FILTER
(REGION 9)

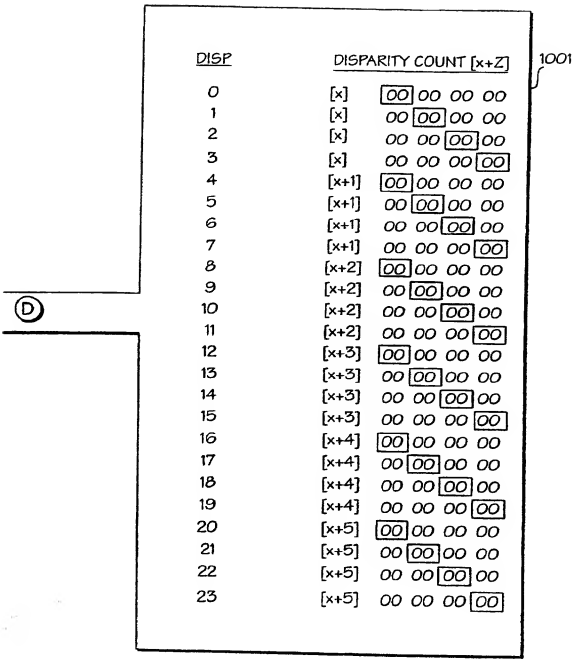


FIG. 44(B)

20130022802 A1 2013.01.24

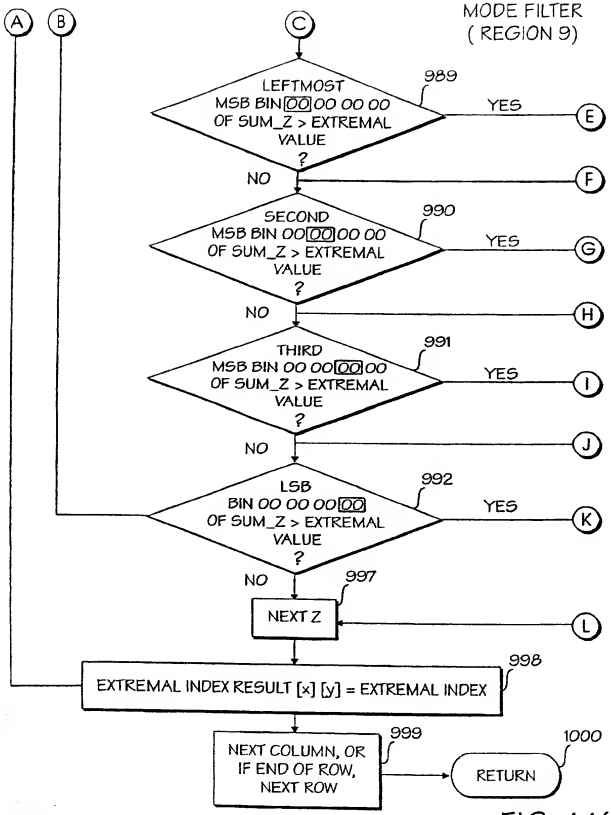

MODE FILTER
(REGION 9)
A
B
C
LEFTMOST MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
989
YES
E
NO
F
SECOND MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
990
YES
G
NO
H
THIRD MSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
991
YES
I
NO
J
LSB BIN 00 00 00 00 OF SUM_Z > EXTREMAL VALUE ?
992
YES
K
NO
997
NEXT Z
L
998
EXTREMAL INDEX RESULT [x] [y] = EXTREMAL INDEX
999
NEXT COLUMN, OR IF END OF ROW, NEXT ROW
1000
RETURN

FIG. 44(C)

20120258020A1

MODE FILTER
(REGION 9)

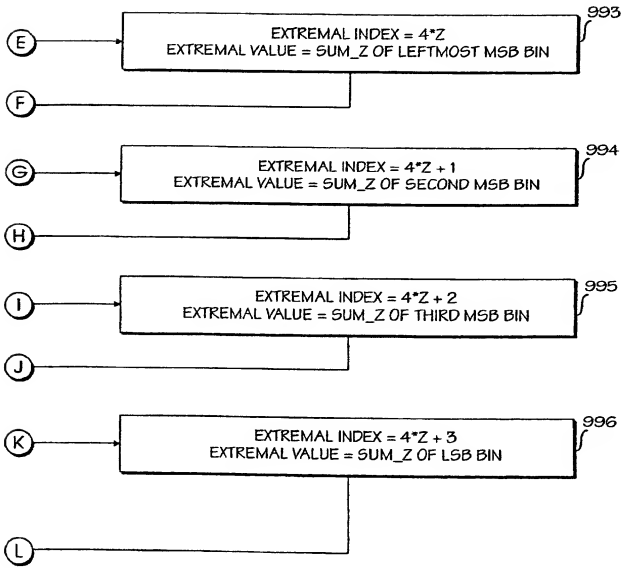


FIG. 44(D)

20120023880201

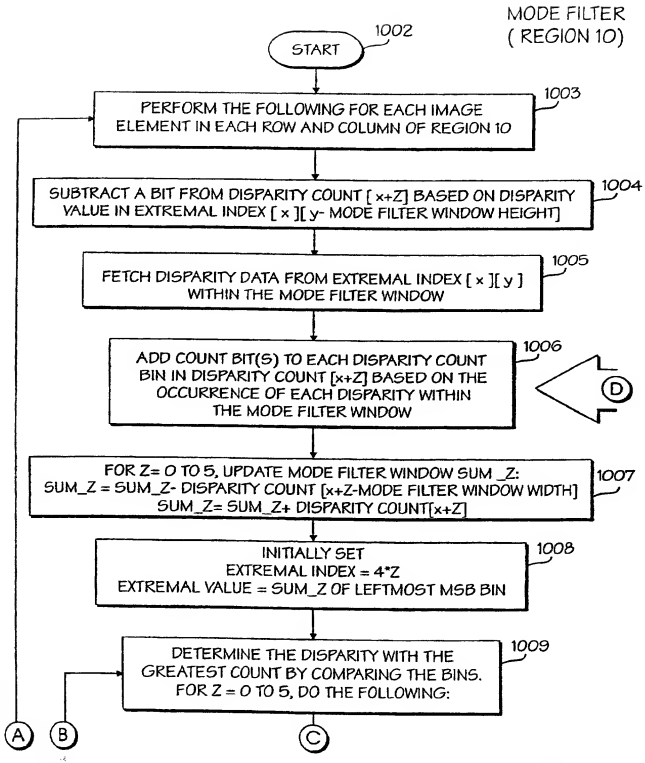


FIG. 45(A)

MODE FILTER
(REGION 10)

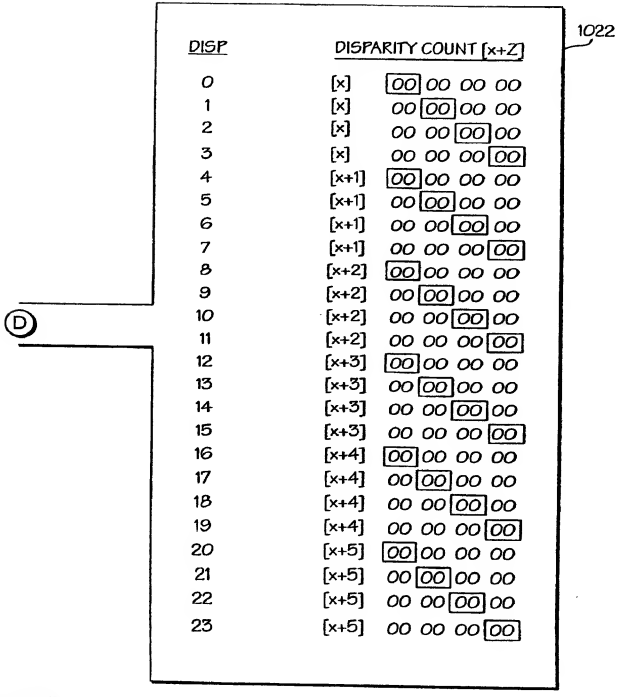


FIG. 45(B)

US 2002/0122102 A1

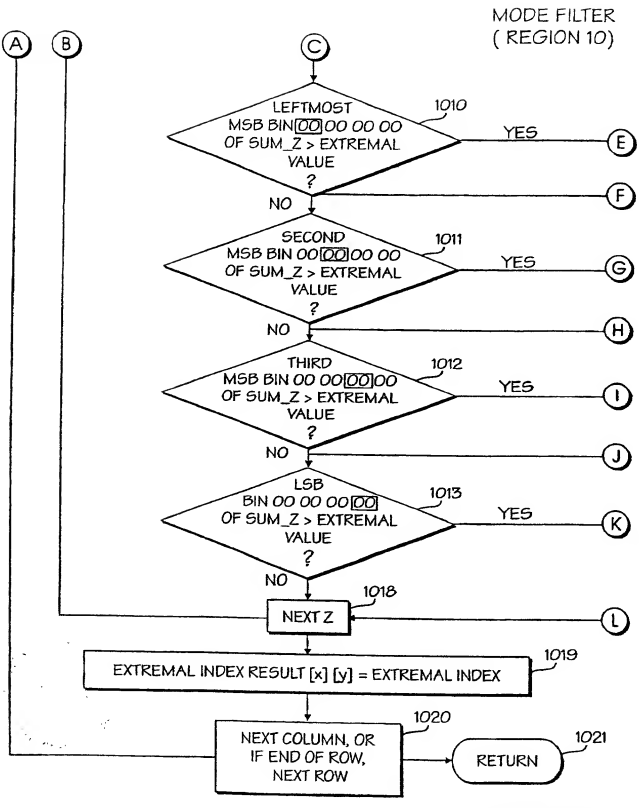

MODE FILTER
(REGION 10)
A
B
C
LEFTMOST
MSB BIN[00]00 00 00
OF SUM_Z > EXTREMAL
VALUE
?
1010
YES
E
NO
F
SECOND
MSB BIN 00[00]00 00
OF SUM_Z > EXTREMAL
VALUE
?
1011
YES
G
NO
H
THIRD
MSB BIN 00 00[00]00
OF SUM_Z > EXTREMAL
VALUE
?
1012
YES
I
NO
J
LSB
BIN 00 00 00[00]
OF SUM_Z > EXTREMAL
VALUE
?
1013
YES
K
NO
NEXT Z
1018
L
EXTREMAL INDEX RESULT [x] [y] = EXTREMAL INDEX
1019
NEXT COLUMN, OR
IF END OF ROW,
NEXT ROW
1020
RETURN
1021

FIG. 45(C)

20120129802001

MODE FILTER
(REGION 10)

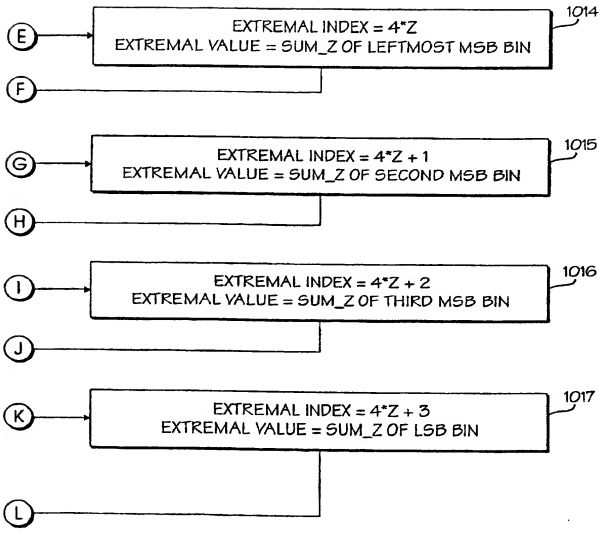


FIG. 45(D)

20120829802001

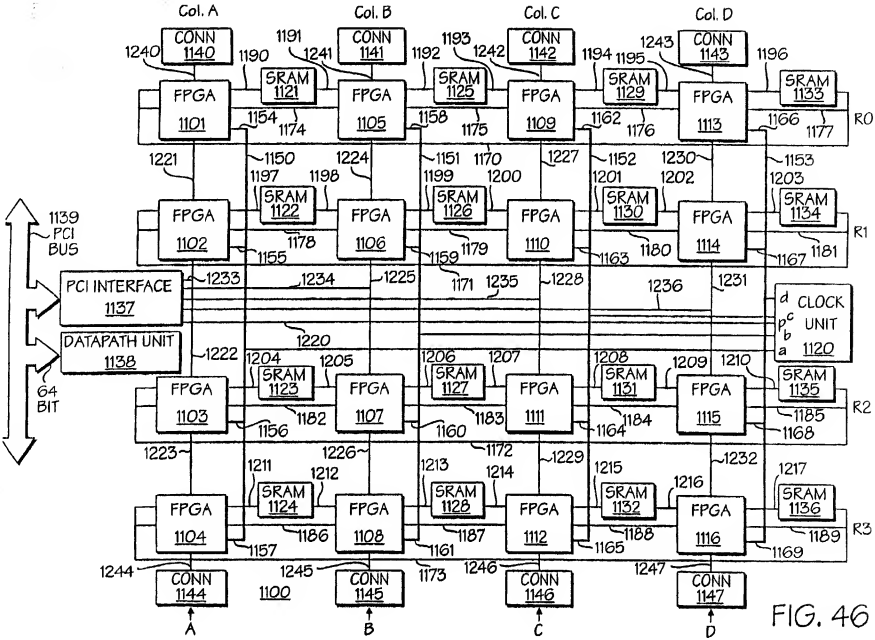


FIG. 46

20120829.2980200T

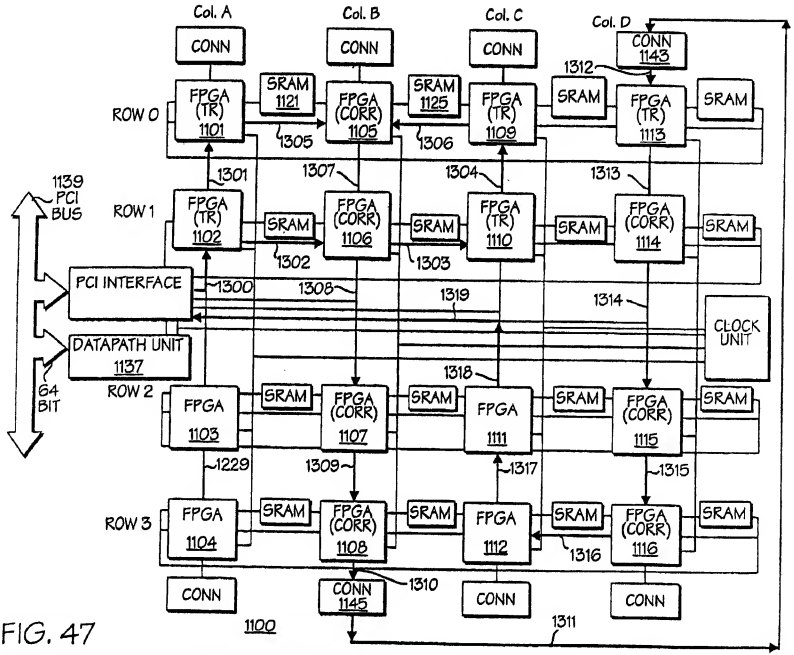


FIG. 47

20120-2580200.1

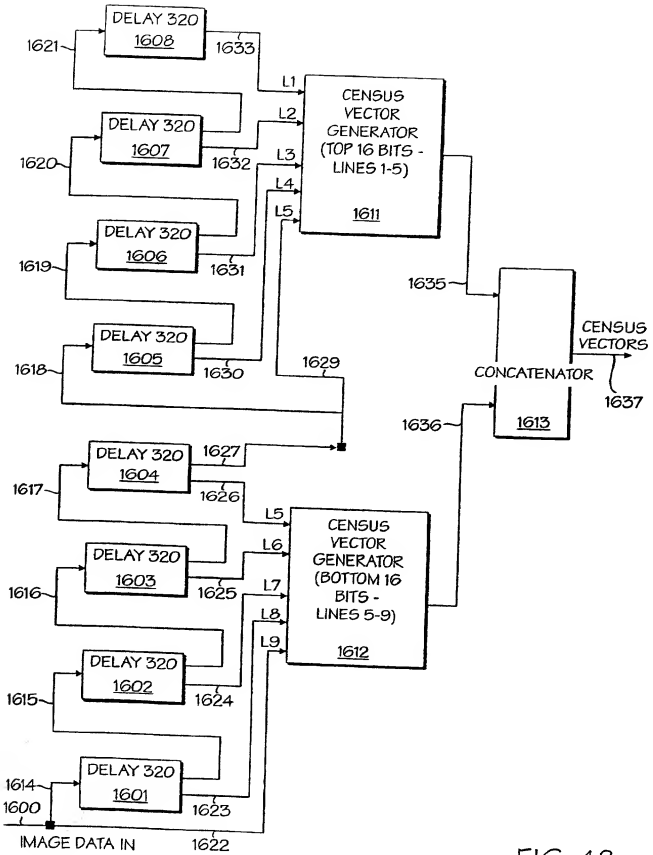


FIG. 48

20130258001

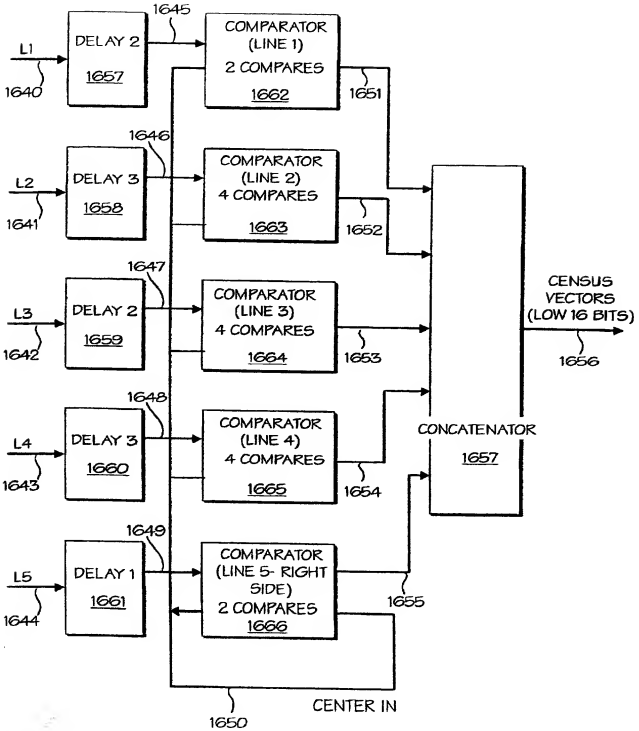


FIG. 49

20120229802001

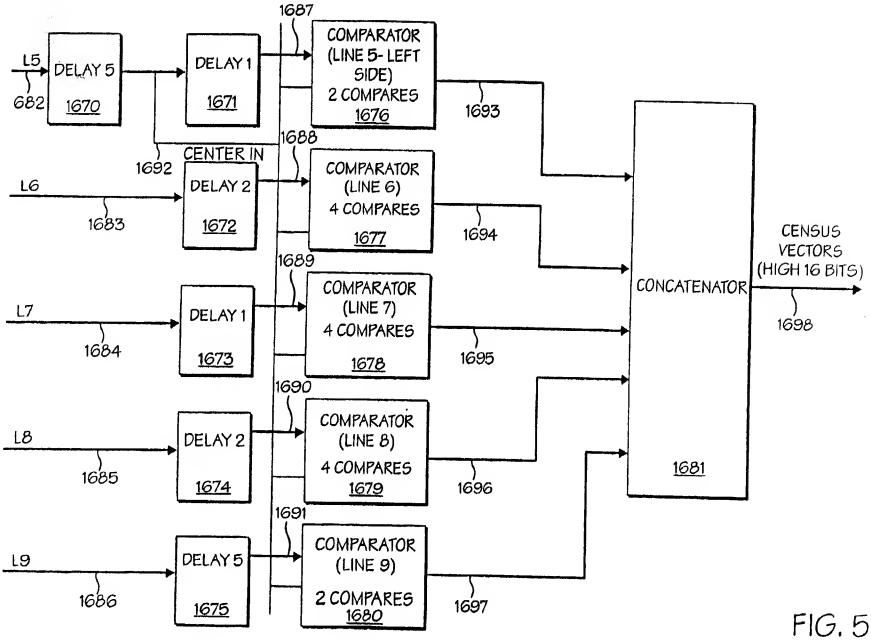


FIG. 50

US 6,298,362 B1

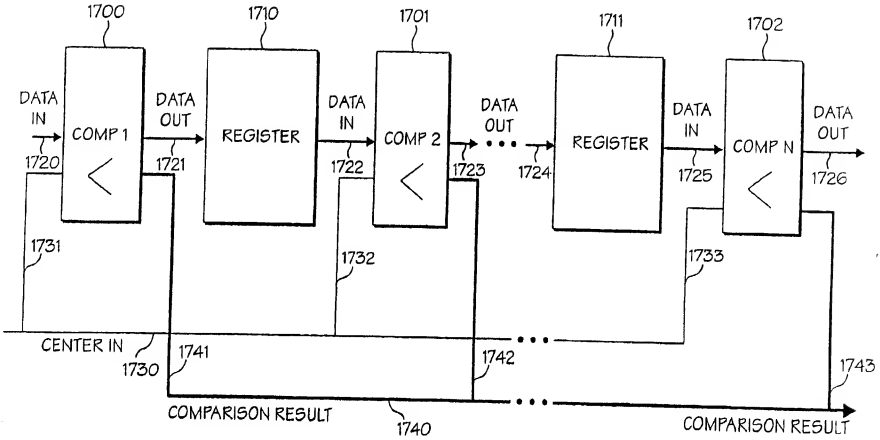


FIG. 51

20120802.0320102

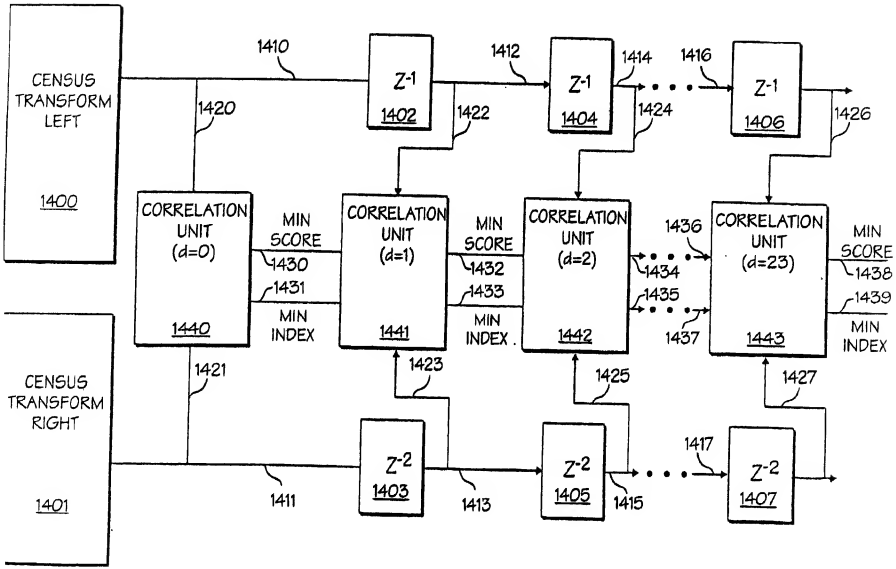


Fig. 52

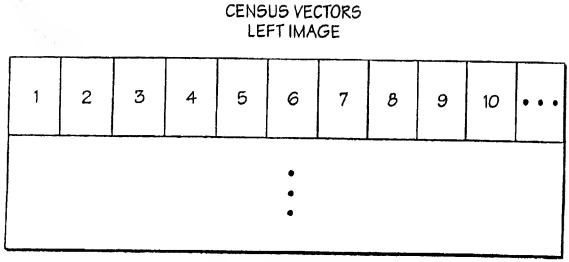


Fig. 53(A)

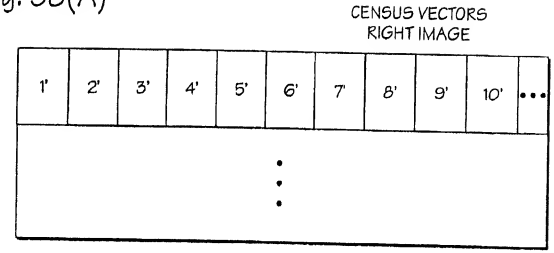


Fig. 53(B)

EP 1 232 494 B1 2005-08-10

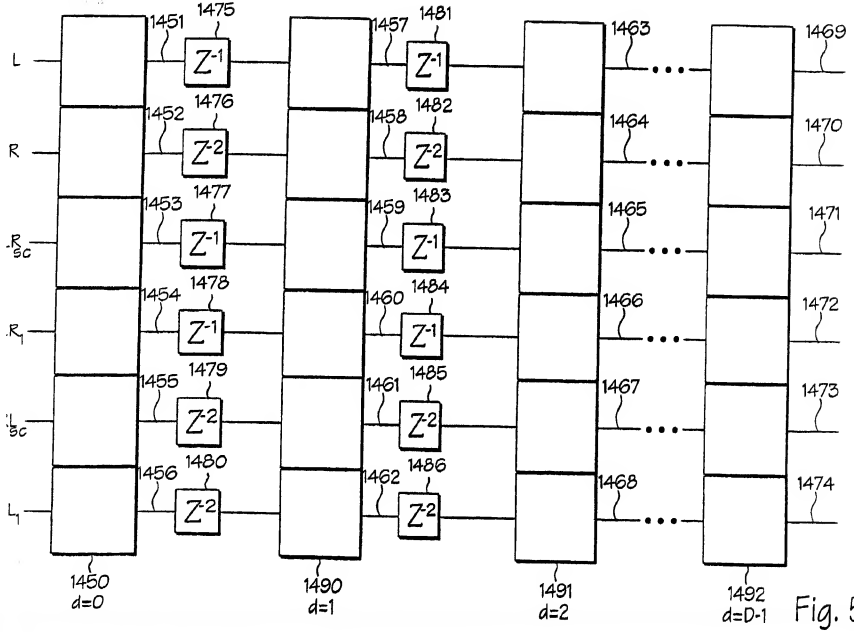


Fig. 54

20120829029802001

15 IMAGE ELEMENTS (1 TO 15 FOR L; 1' TO 15' FOR R)
D=5 (d= {0, 1, 2, 3, 4})

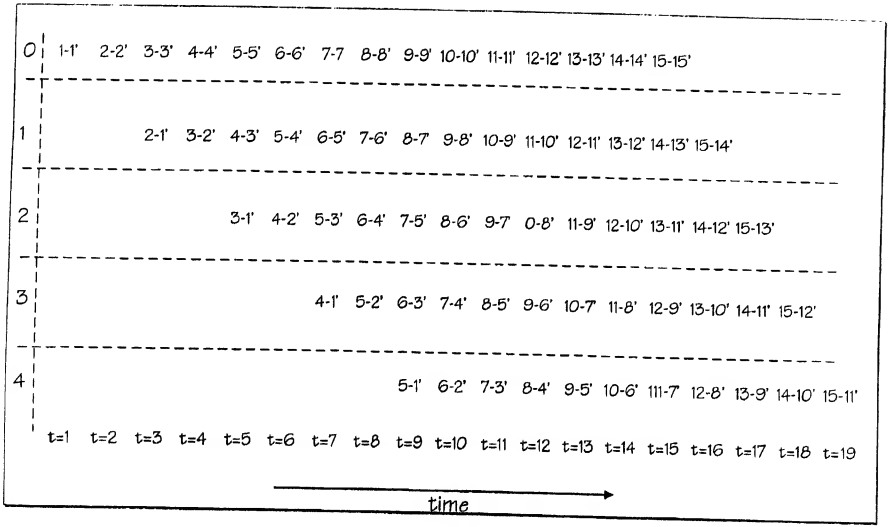


FIG. 55

20130208-2980210

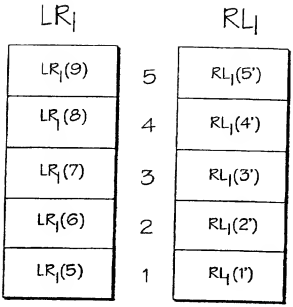


Fig. 56(A)

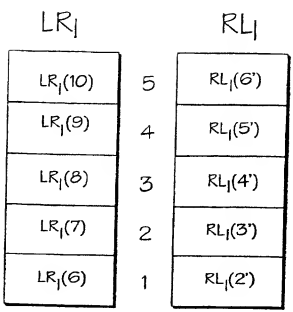


Fig. 56(B)

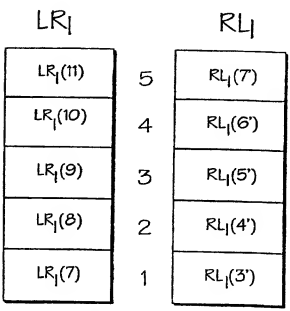


Fig. 56(C)

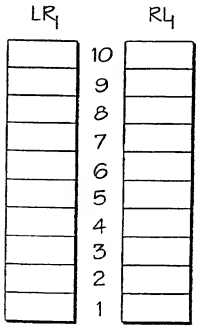


Fig. 56(D)

20120-2580200.1

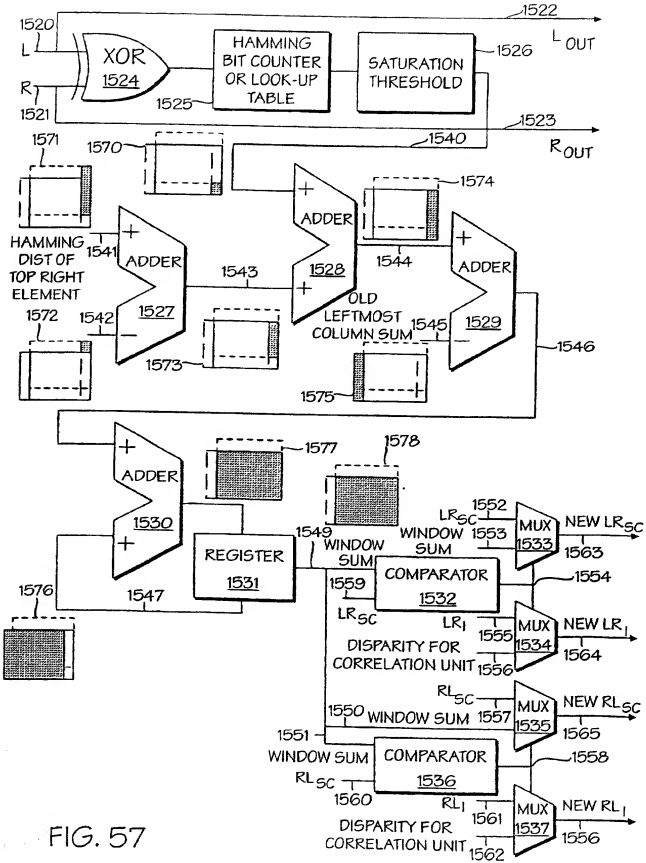


FIG. 57

20120862-032102

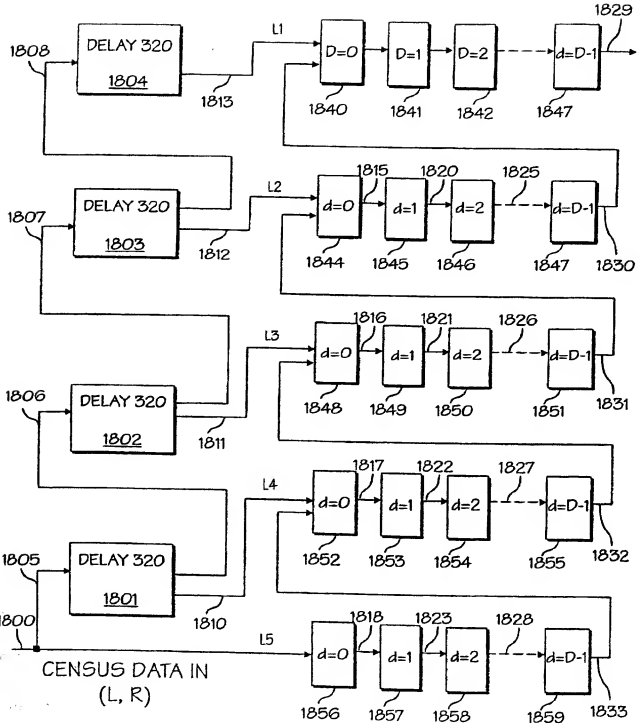


FIG. 58

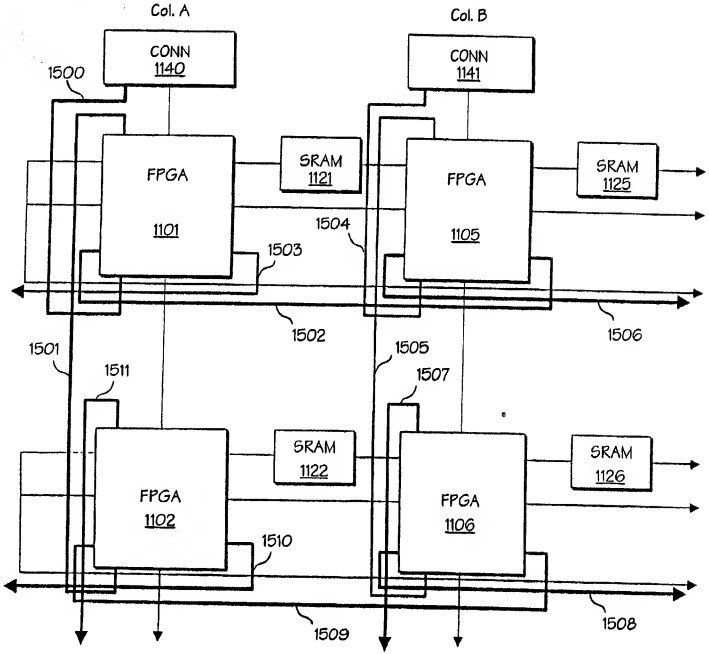

Col. A
Col. B
CONN
1140
CONN
1141
1500
FPGA
1101
SRAM
1121
FPGA
1105
SRAM
1125
1504
1503
1502
1506
1501
1511
1505
1507
SRAM
1122
FPGA
1102
FPGA
1106
SRAM
1126
1510
1509
1508

FIG. 59

20130352102 US 2013-0352102 A1

Fig. 60

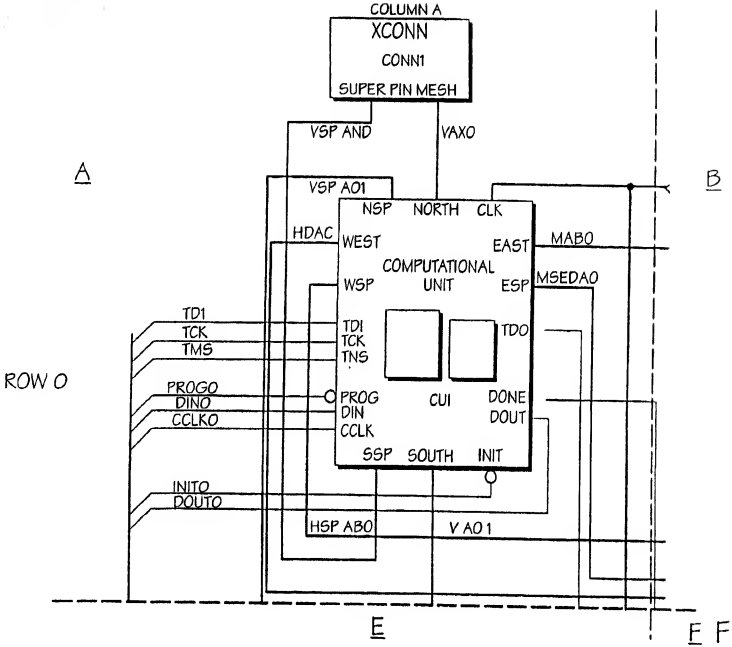

COLUMN A
XCONN
CONN1
SUPER PIN MESH
VSP AND
VAXO
A
B
VSP AO1
NSP
NORTH
CLK
HDAC
WEST
EAST
MABO
COMPUTATIONAL
WSP
UNIT
ESP
MSEDAO
TD1
TCK
TMS
TDI
TCK
TNS
TDO
ROW O
PROGO
DINO
CCLKO
PROG
DIN
CCLK
CUI
DONE
DOUT
SSP
SOUTH
INIT
INITO
DOUTO
HSP ABO
V AO 1
E
E

Fig. 60A

20120ED "29802001

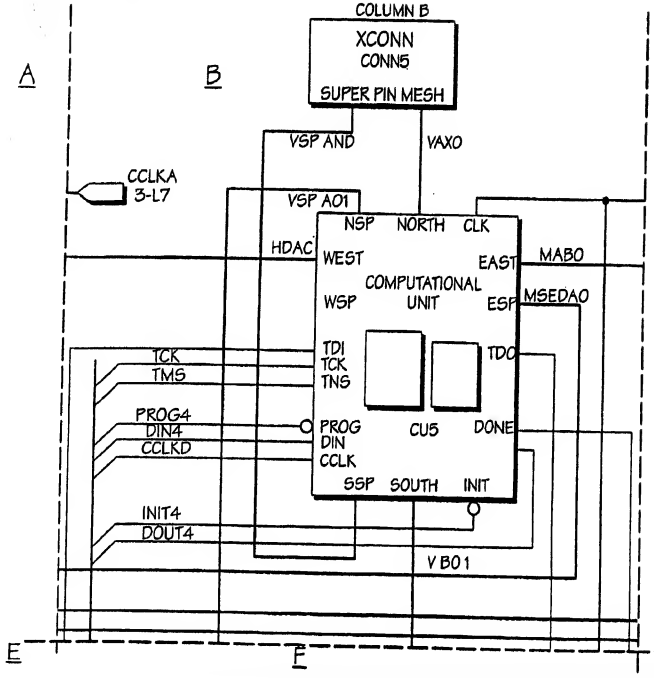


Fig. 60B

20250329802001

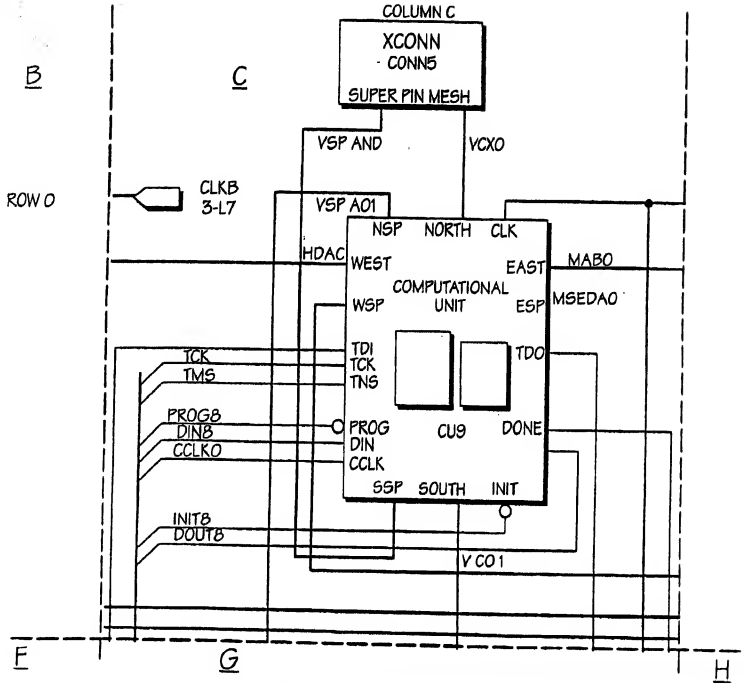


Fig. 60C

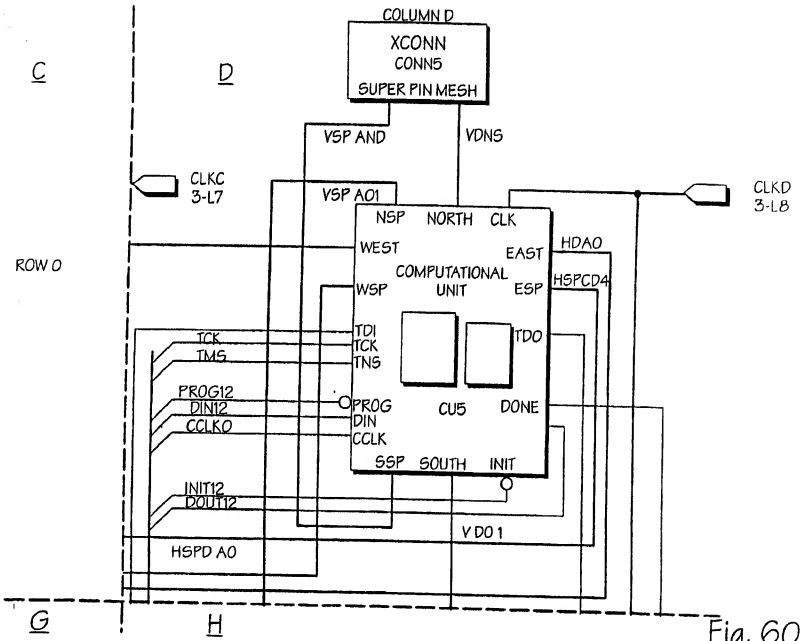

COLUMN D
XCONN
CONN5
SUPER PIN MESH
C
D
VSP AND
VDN5
CLKC
3-L7
VSP A01
CLKD
3-L8
NSP
NORTH
CLK
WEST
EAST
HDA0
ROW 0
COMPUTATIONAL
UNIT
WSP
ESP
HSPCD4
TDI
TCK
TMS
TDO
TCK
TMS
PROG12
DIN12
CCLK0
PROG
DIN
CCLK
CU5
DONE
SSP
SOUTH
INIT
INIT12
DOUT12
V D0 1
HSPD A0
G
H

Fig. 60D

20120229802001

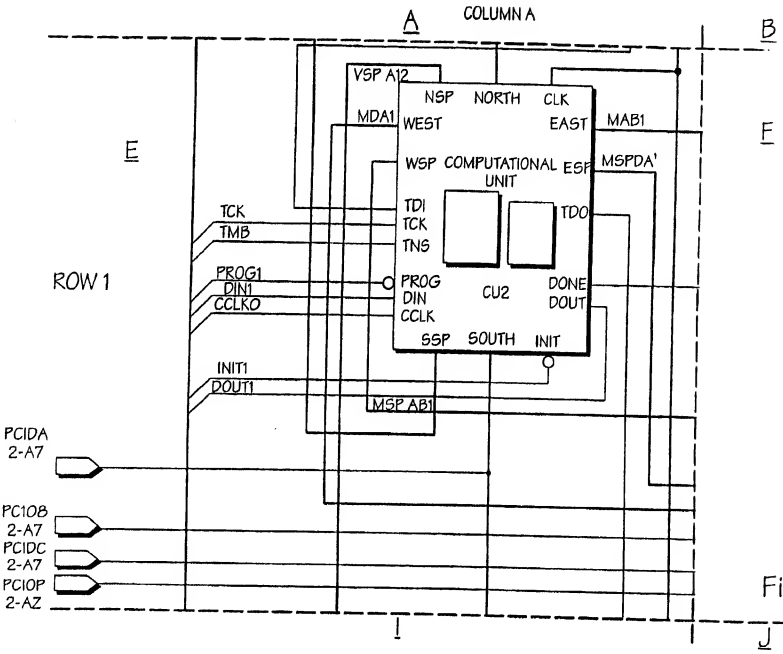


Fig. 60E

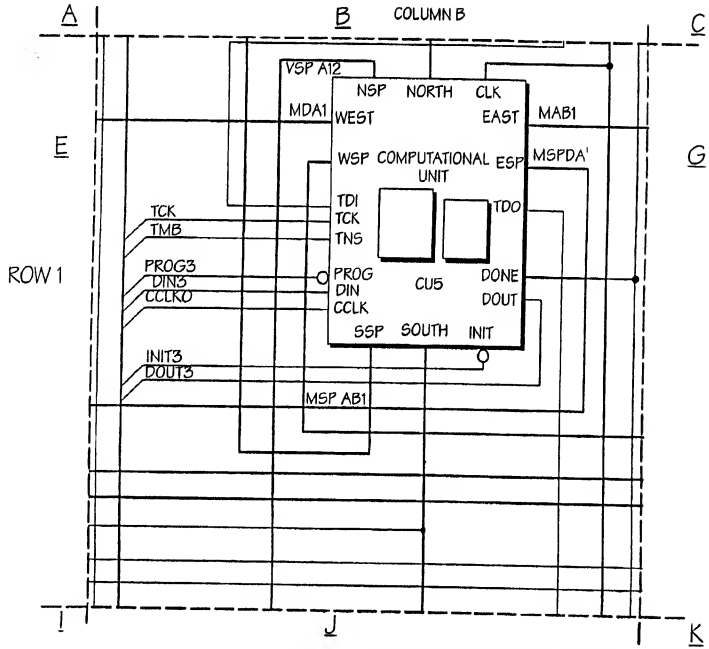

A
B
COLUMN B
C
VSP A12
NSP
NORTH
CLK
MDA1
WEST
EAST
MAB1
E
WSP
COMPUTATIONAL
UNIT
ESP
MSPDA'
G
TDI
TCK
TMS
TDO
TCK
TMB
ROW 1
PROG3
DIN3
CCLK0
PROG
DIN
CCLK
CU5
DONE
DOUT
SSP
SOUTH
INIT
INIT3
DOUT3
MSP AB1
I
J
K

Fig. 60F

20120803 29802001

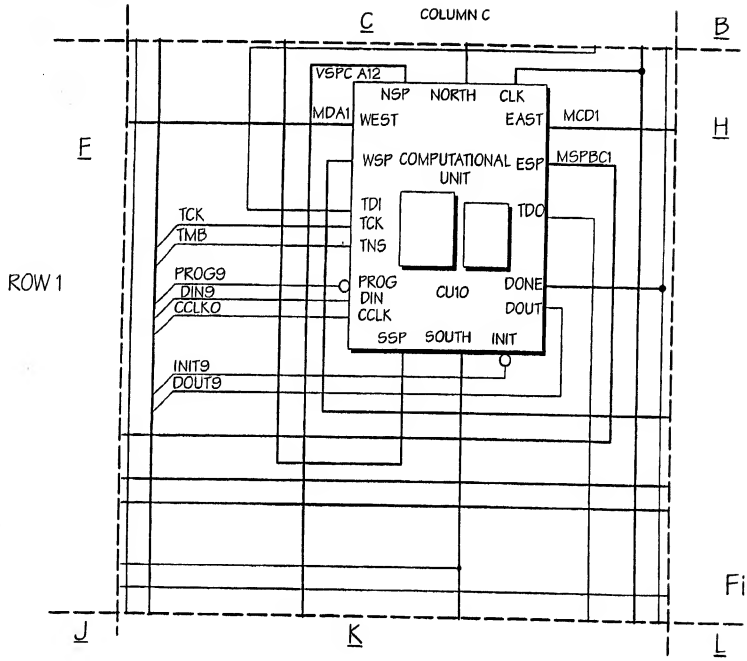


Fig. 60G

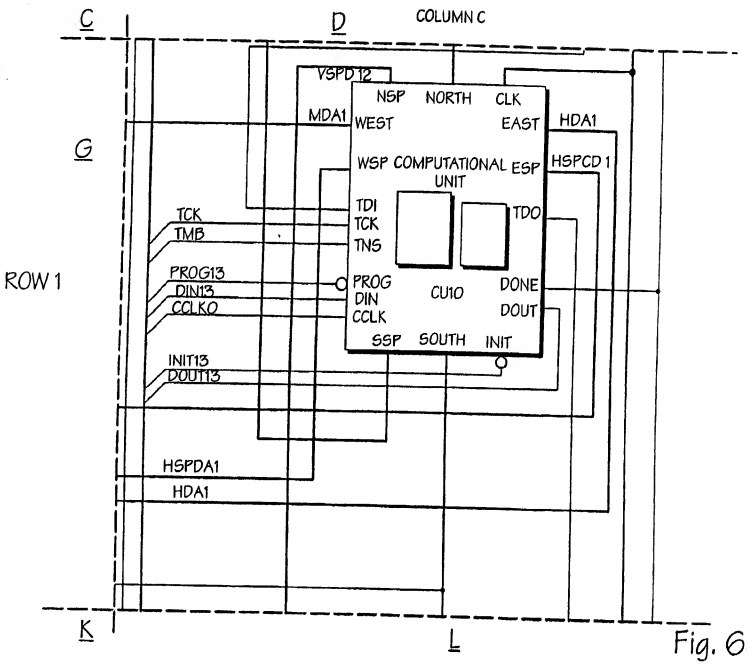

C
D
COLUMN C
G
ROW 1
K
L
VSPD12
NSP
NORTH
CLK
MDA1
WEST
EAST
HDA1
WSP
COMPUTATIONAL
UNIT
ESP
HSPCD1
TDI
TCK
TMS
TDO
TCK
TMB
PROG13
DIN13
CCLK0
PROG
DIN
CCLK
CU10
DONE
DOUT
SSP
SOUTH
INIT
INIT13
DOUT13
HSPDA1
HDA1

Fig. 60H

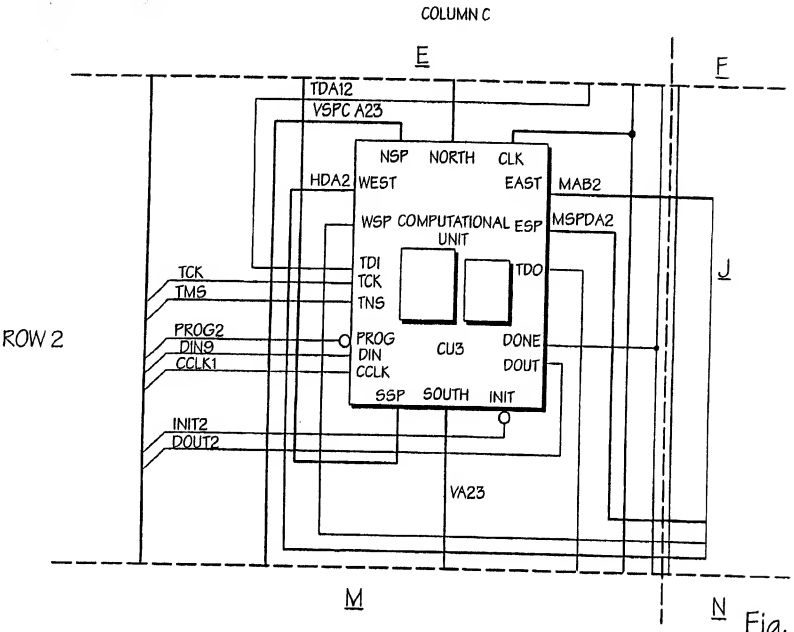

COLUMN C
E
F
TDA12
VSPC A23
NSP
NORTH
CLK
HDA2
WEST
EAST
MAB2
WSP
COMPUTATIONAL
UNIT
ESP
MSPDA2
TDI
TCK
TMS
TDO
J
ROW 2
PROG2
DIN9
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT2
DOUT2
VA23
M
N

Fig. 601

20120802 "29802001

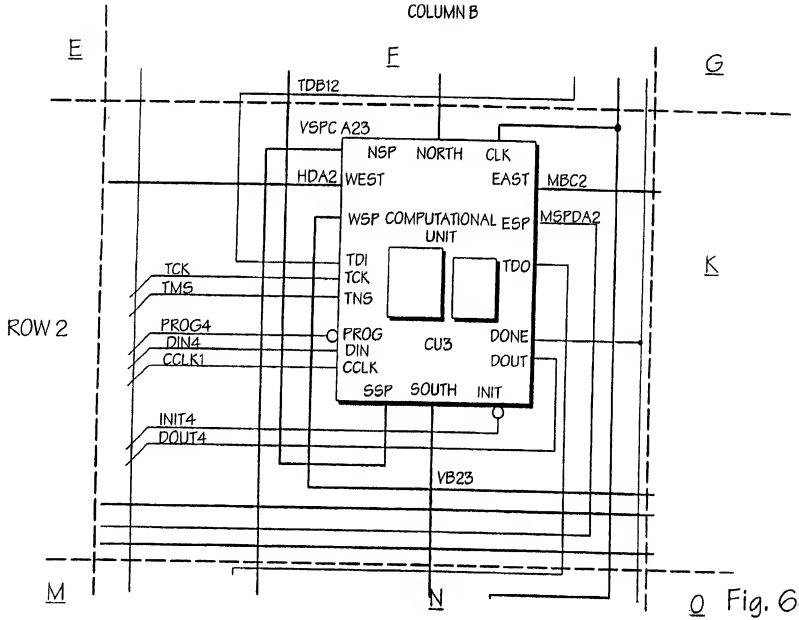


Fig. 60J

20120529802001

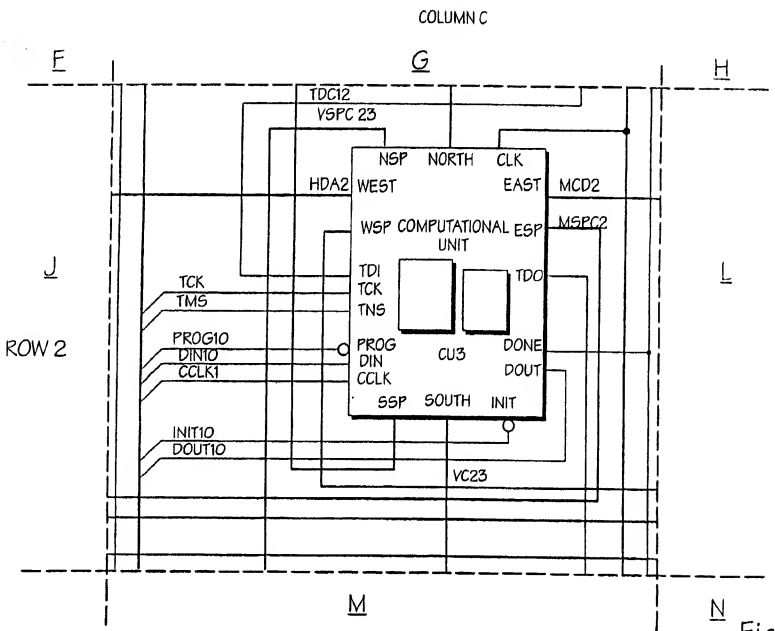


Fig. 60K

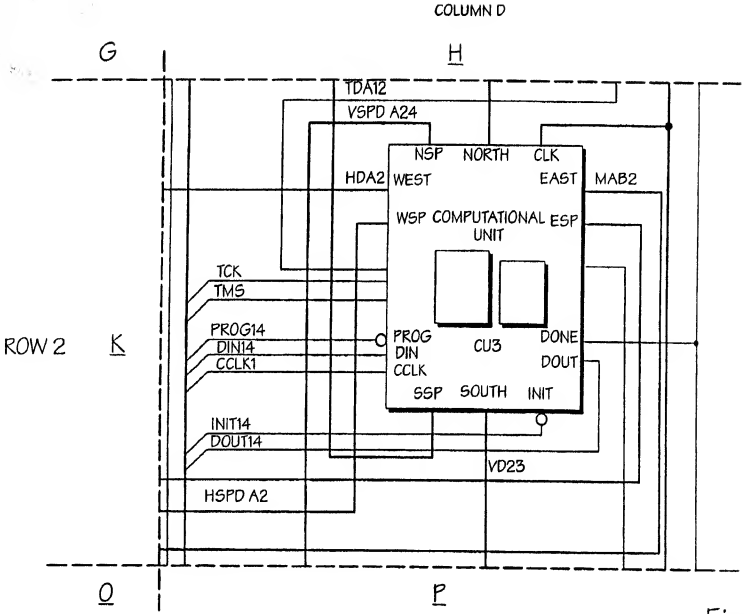

COLUMN D
G
H
TDA12
VSPD A24
NSP
NORTH
CLK
HDA2
WEST
EAST
MAB2
WSP COMPUTATIONAL
UNIT
ESP
TCK
TMS
ROW 2
K
PROG14
DIN14
CCLK1
PROG
DIN
CCLK
CU3
DONE
DOUT
SSP
SOUTH
INIT
INIT14
DOUT14
VD23
HSPD A2
Q
P

Fig. 60L

20120-25802001

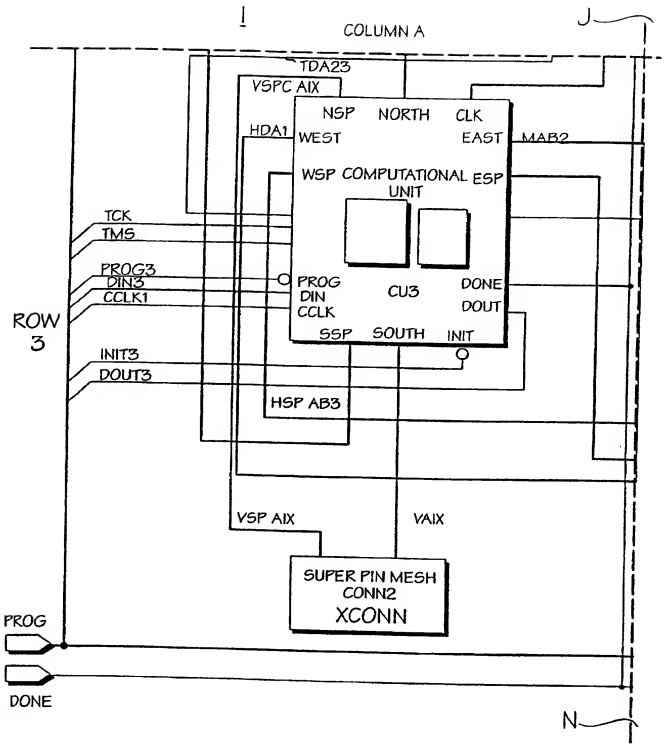


Fig. 60M

20120329025802001

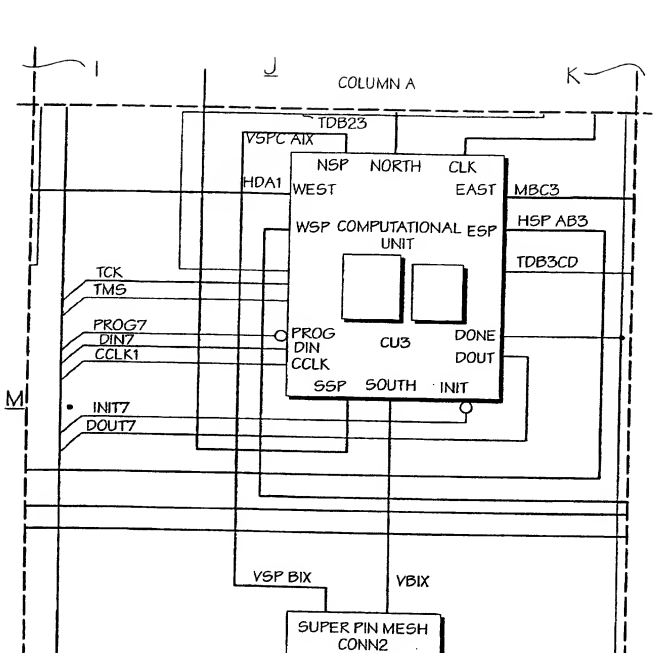


Fig. 60N

20120229802001

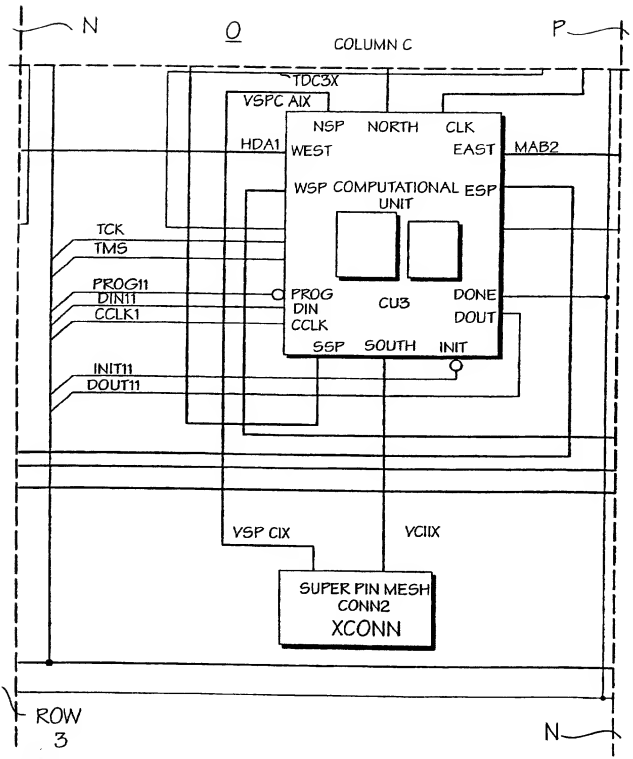


Fig. 600

20120129802001

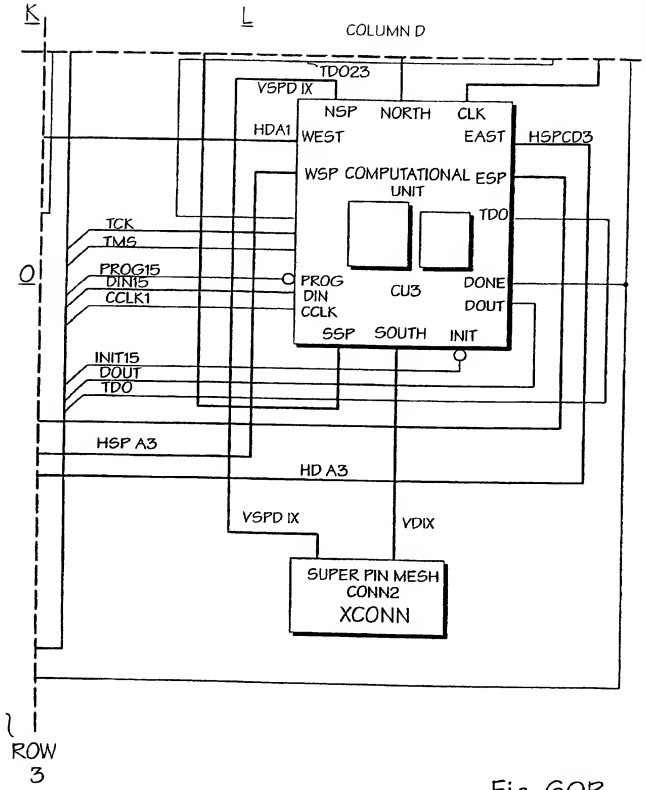


Fig. 60P

20120329802001

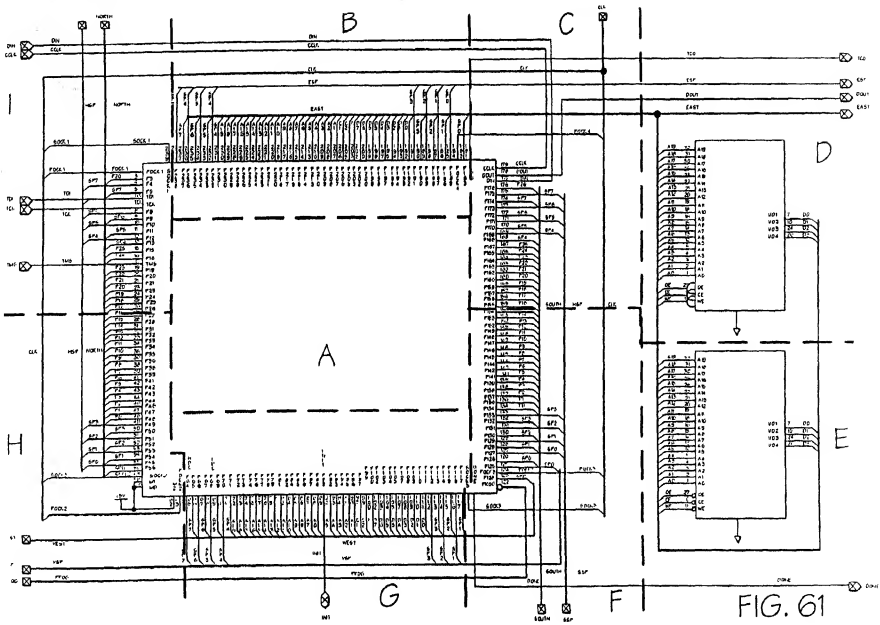


FIG. 61

20120102 "02980201

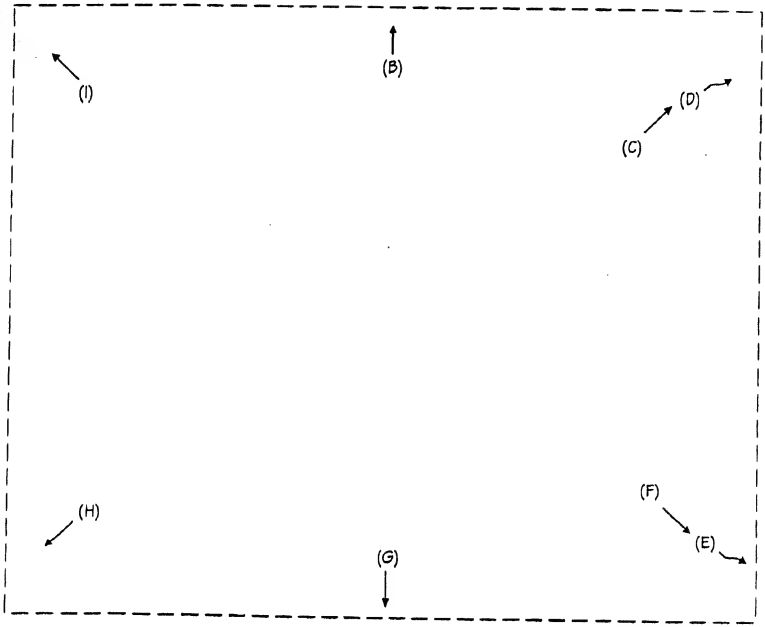


FIG. 61(A)

20120829802001

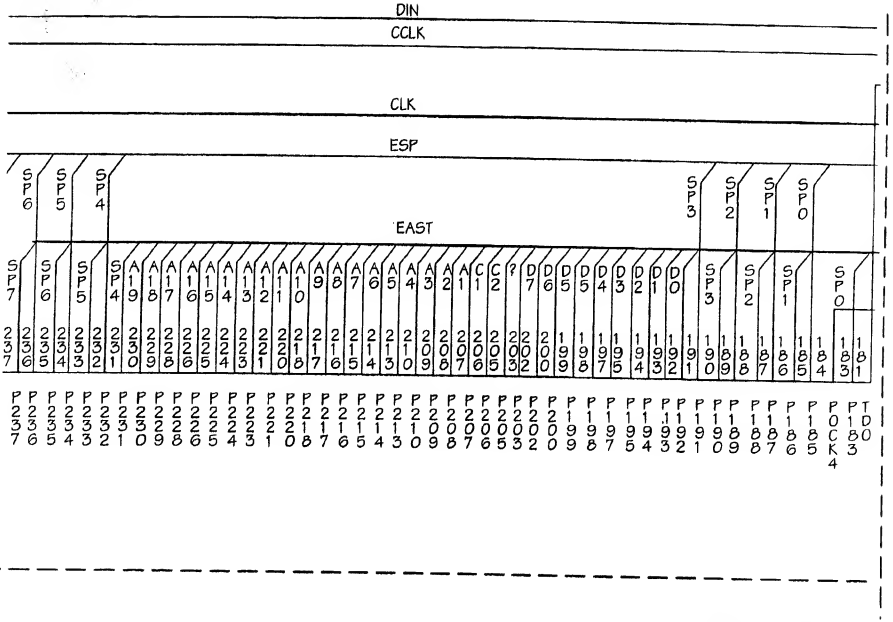
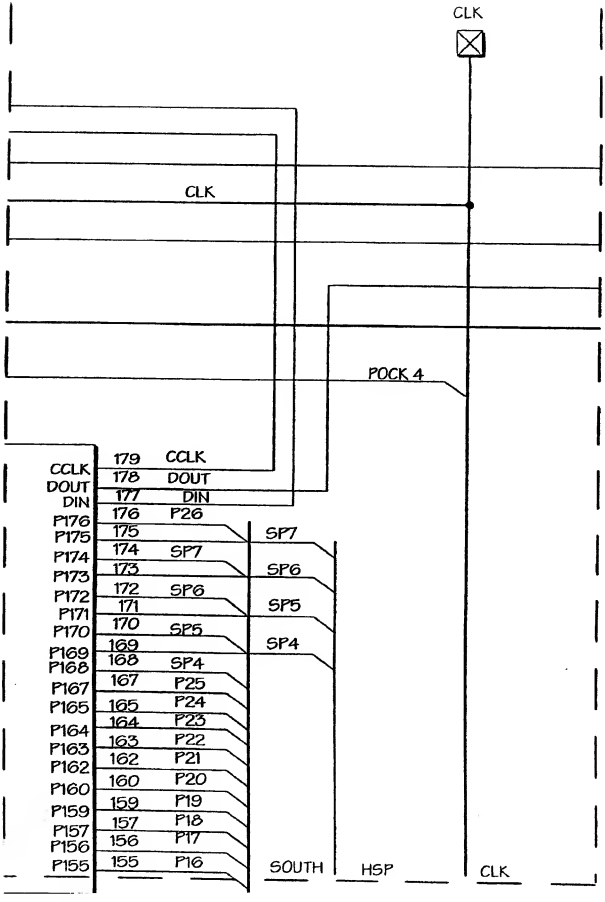


FIG. 61(B)

20120.0-29802001



20120 - 2980240U

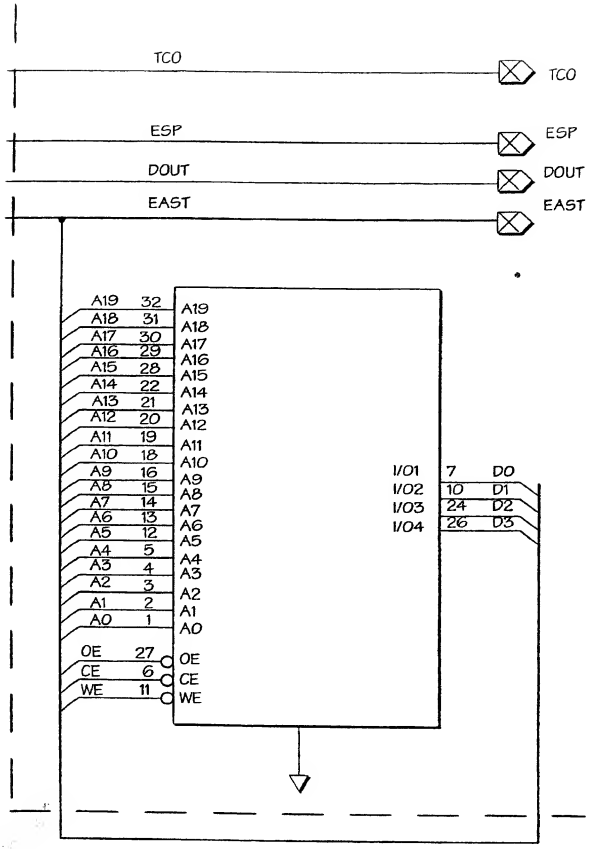


FIG. 61(D)

20120-2980200T

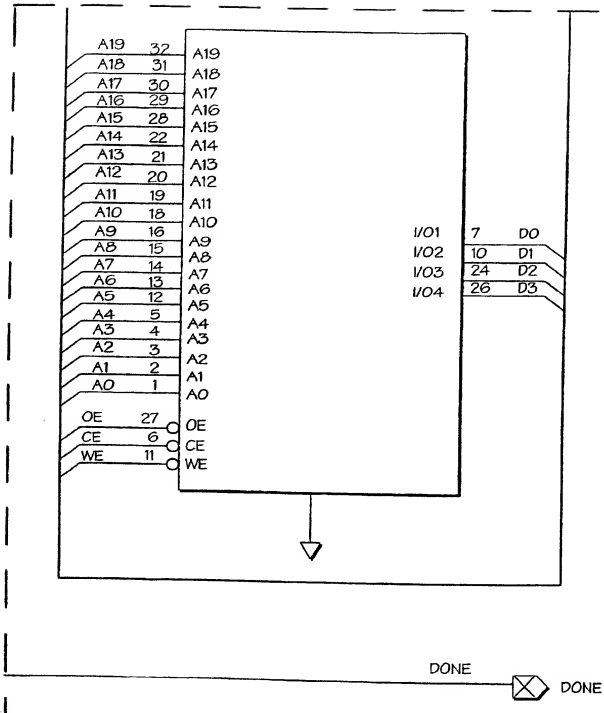


FIG. 61(E)

20020-25802001

FIG. 61(F)

20120298020T

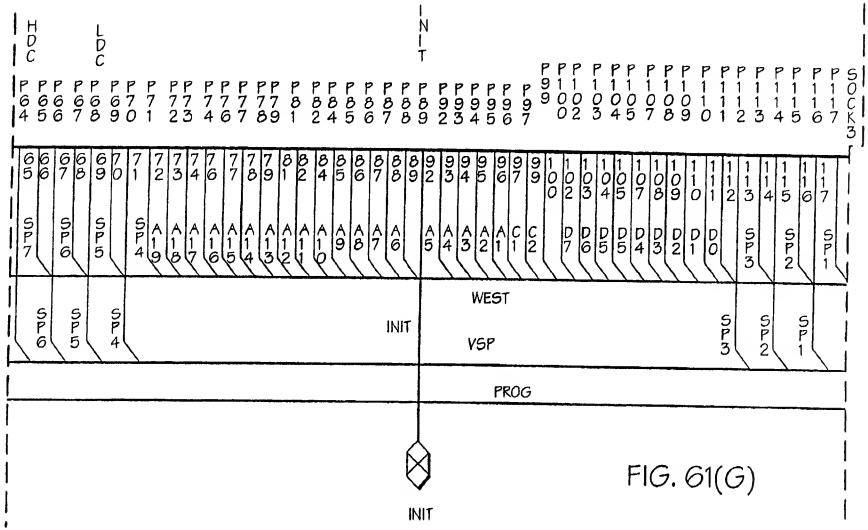


FIG. 61(G)

20120-2580201

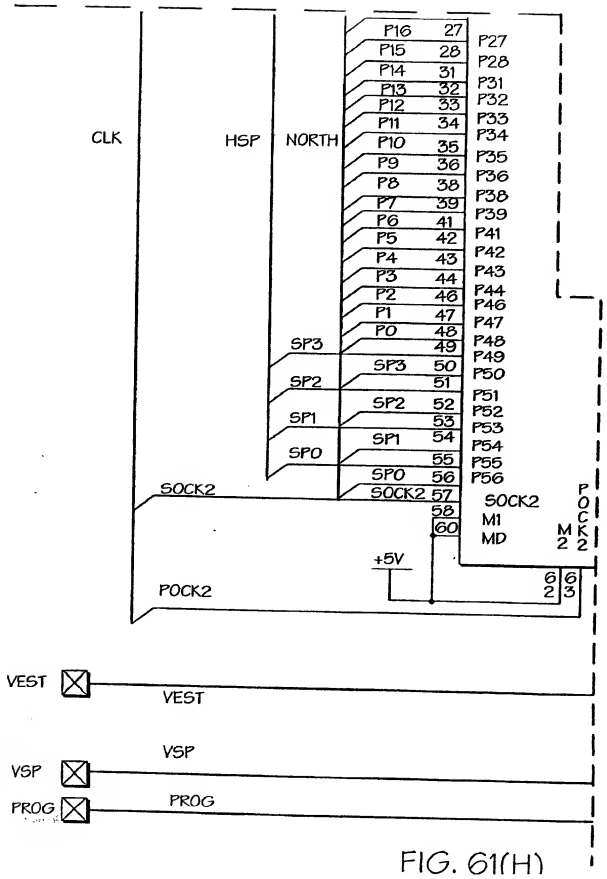


FIG. 61(H)

20120325802001

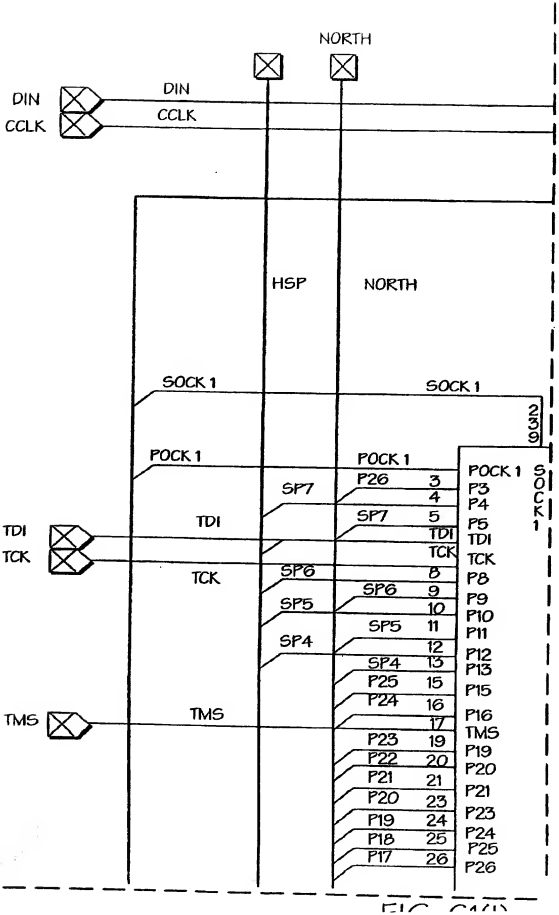


FIG. 64(1)

4002086S .032102

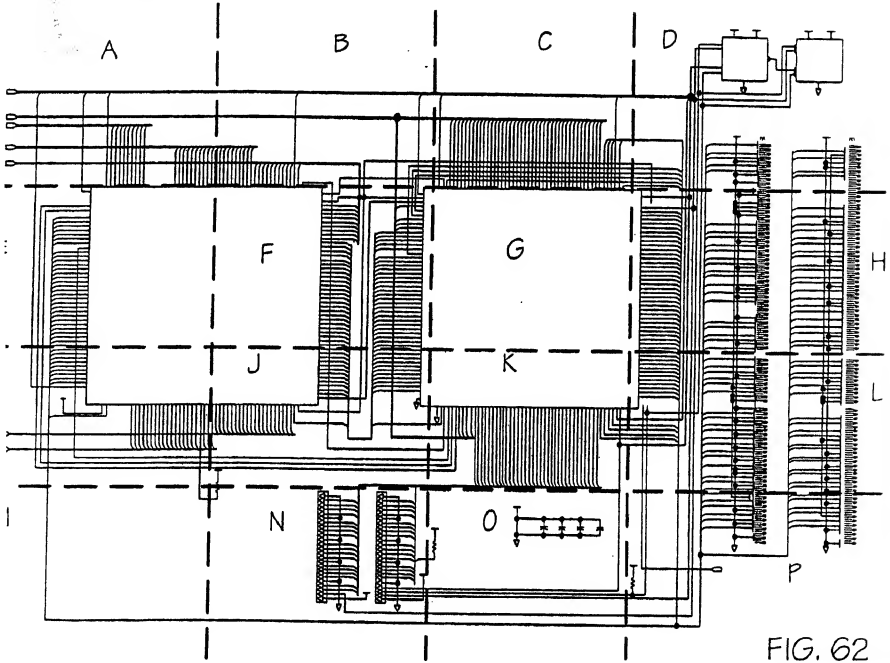
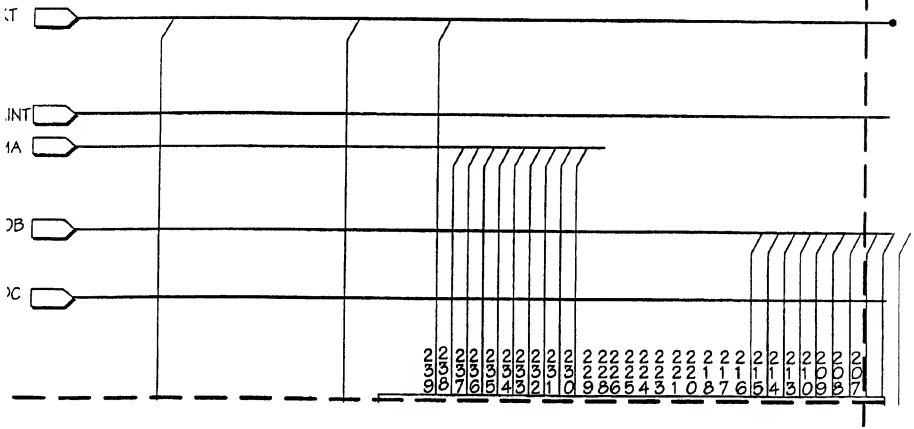


FIG. 62

FIG. 62(A)


XT
INT
1A
DB
DC
2390
2391
2392
2393
2394
2395
2396
2397
2398
2399
2310
2311
2312
2313
2314
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2321
2322
2323
2324
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2326
2327
2328
2329
2330
2331

20120802 .0825001

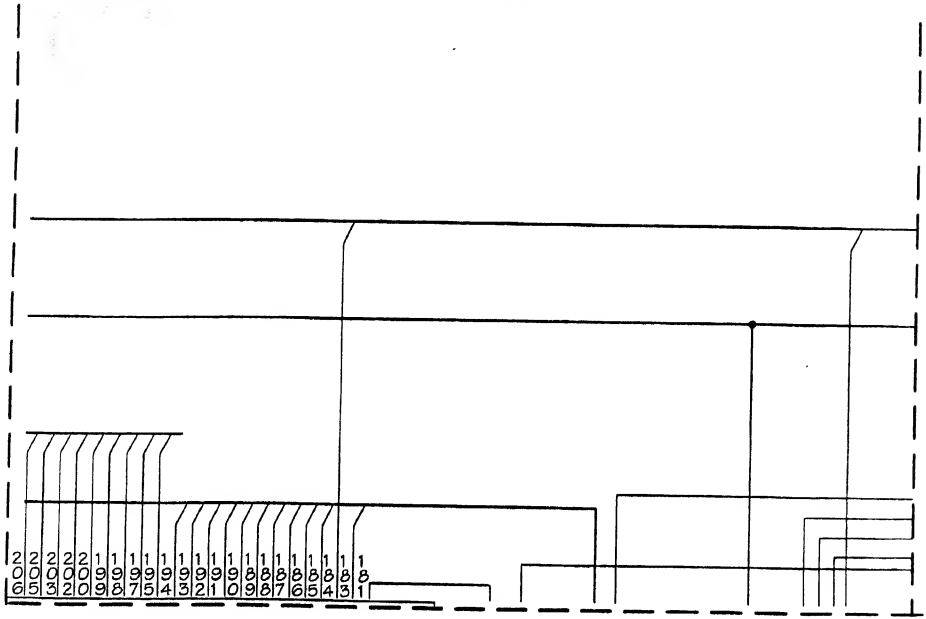


FIG. 62(B)

FIG. 62(C)

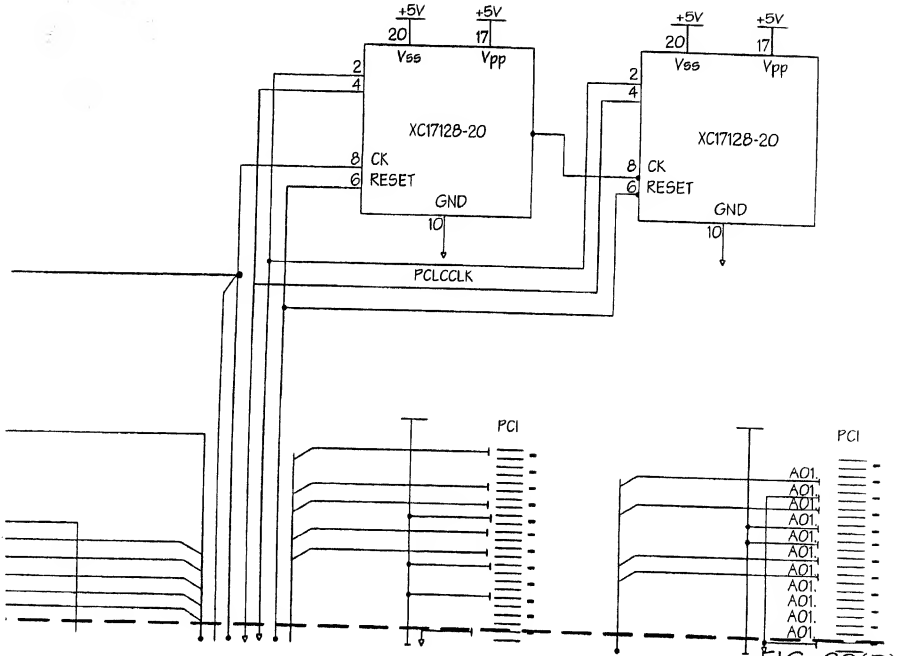

+5V
20
Vss
+5V
17
Vpp
2
4
XC17128-20
8
CK
6
RESET
GND
10
PCLCCLK
PCI
AO1.

FIG. 62(D)

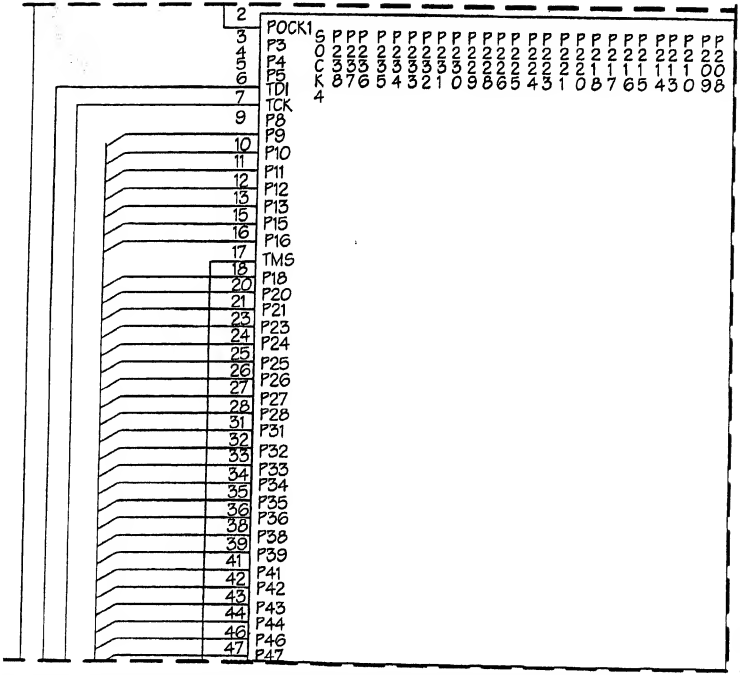
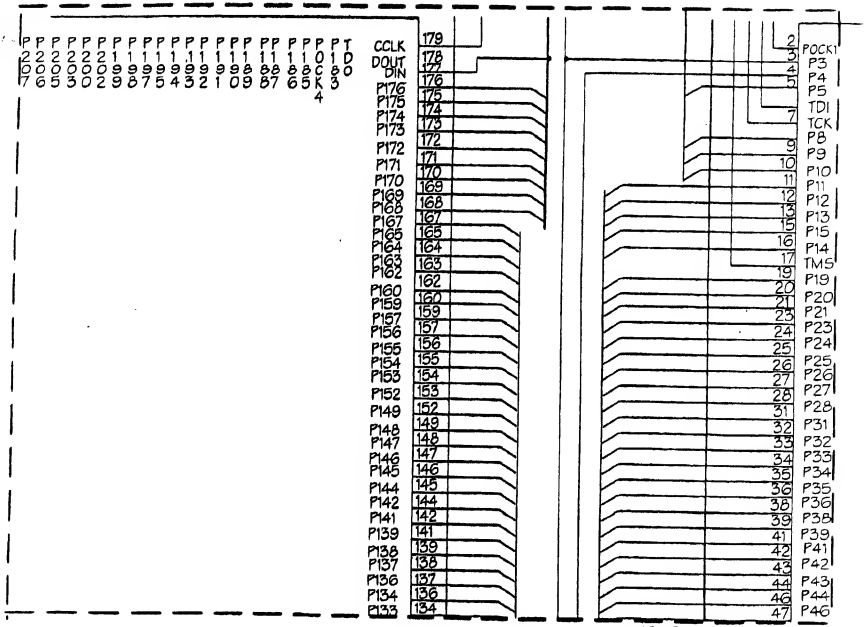

2
3 POCK1
4 P3
5 P4
6 P5
7 TDI
9 TCK
10 P8
11 P9
12 P10
13 P11
15 P12
16 P13
17 P15
18 P16
20 TMS
21 P18
23 P20
24 P21
25 P23
26 P24
27 P25
28 P26
31 P27
32 P28
33 P31
34 P32
35 P33
36 P34
38 P35
39 P36
41 P38
42 P39
43 P41
44 P42
46 P43
47 P44
P46
P47
SOCK4
P2358
P2356
P2354
P2332
P2310
P2298
P2265
P2243
P2221
P2187
P2165
P2143
P2110
P2098

FIG. 62(E)


P207
P206
P205
P200
P199
P198
P197
P196
P195
P194
P193
P192
P111
P110
P109
P108
P107
P106
P105
P104
P103
P102
P101
P100
TDO
CCLK
DOUT
DIN
P176
P175
P174
P173
P172
P171
P170
P169
P168
P167
P165
P164
P163
P162
P160
P159
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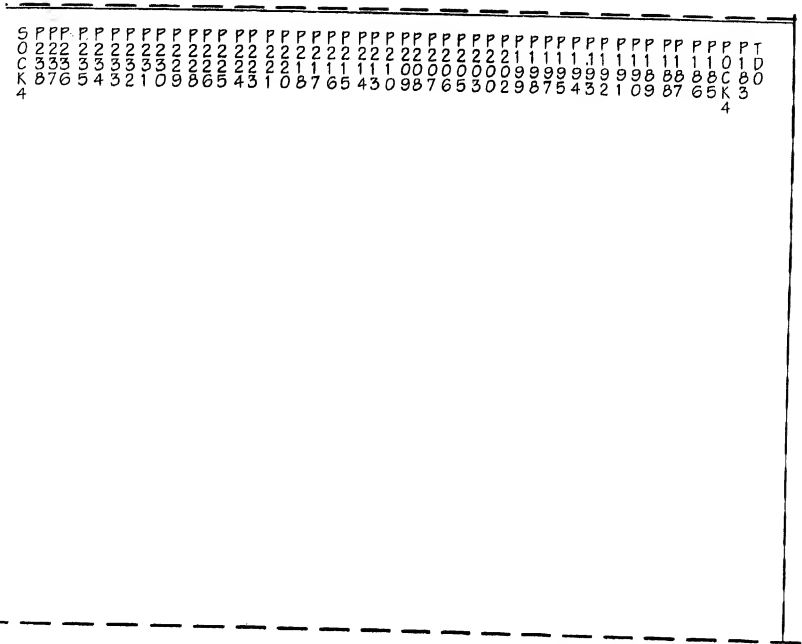
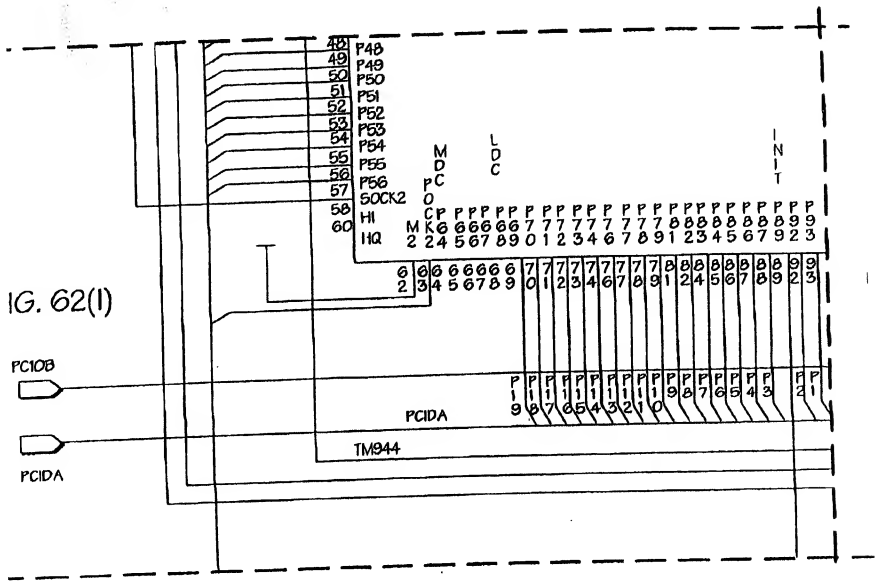
38
39
41
42
43
44
46
47
POCK1
P3
P4
P5
TDI
TCK
P8
P9
P10
P11
P12
P13
P15
P14
TMS
P19
P20
P21
P23
P24
P25
P26
P27
P28
P31
P32
P33
P34
P35
P36
P38
P39
P41
P42
P43
P44
P46

FIG. 62(F)

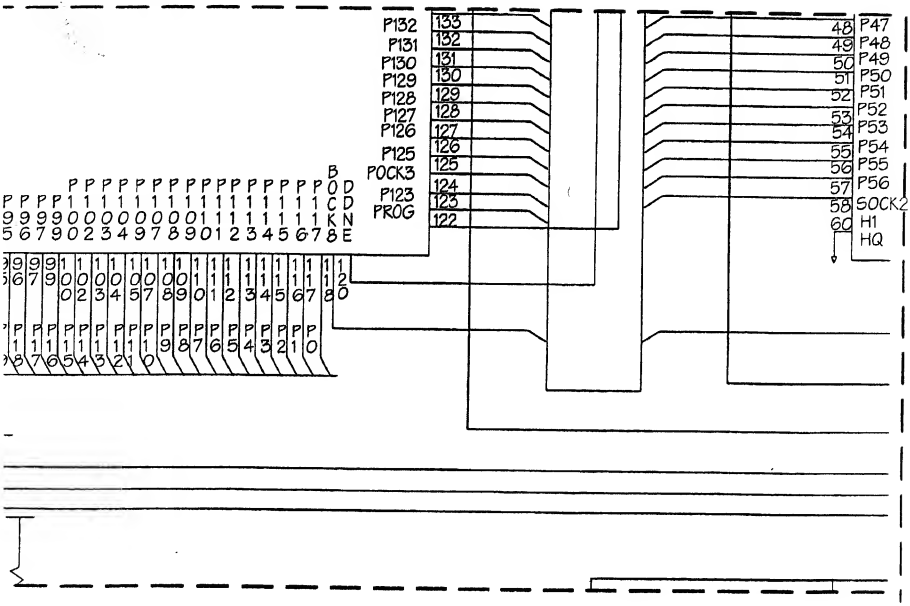

SOCK4
PP2333876
PP2333543
PP2333321
PP2332109
PP2222865
PP2222431
PP2221087
PP2221765
PP2221430
PP2220987
PP2220653
PP2220298
PP2119875
PP2119543
PP2119210
PP2119098
PP2118765
PP2118430
PP2118098
PP2117765
PP2117430
PP2117098
PP2116765
PP2116430
PP2116098
PP2115765
PP2115430
PP2115098
PP2114765
PP2114430
PP2114098
PP2113765
PP2113430
PP2113098
PP2112765
PP2112430
PP2112098
PP2111765
PP2111430
PP2111098
PP2110765
PP2110430
PP2110098
PP2109765
PP2109430
PP2109098
PP2108765
PP2108430
PP2108098
PP2107765
PP2107430
PP2107098
PP2106765
PP2106430

20120029802001

FIG. 62(H)


48 P48
49 P49
50 P50
51 P51
52 P52
53 P53
54 P54
55 P55
56 P56
57 SOCK2
58 HI
60 HQ
MD PC
LDC
INIT
PC10B
PCIDA
PCIDA
TM944

IG. 62(1)


P132
P131
P130
P129
P128
P127
P126
P125
POCK3
P123
PROG
133
132
131
130
129
128
127
126
125
124
123
122
48 P47
49 P48
50 P49
51 P50
52 P51
53 P52
54 P53
55 P54
56 P55
57 P56
58 SOCK2
60 H1
HQ
P P P

1002080852 · 03/21/02

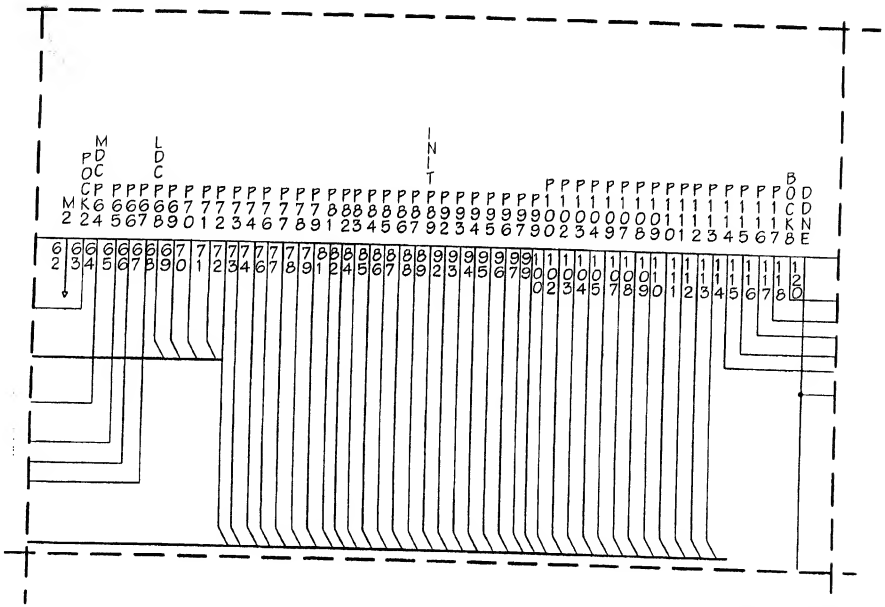


FIG. 62(K)

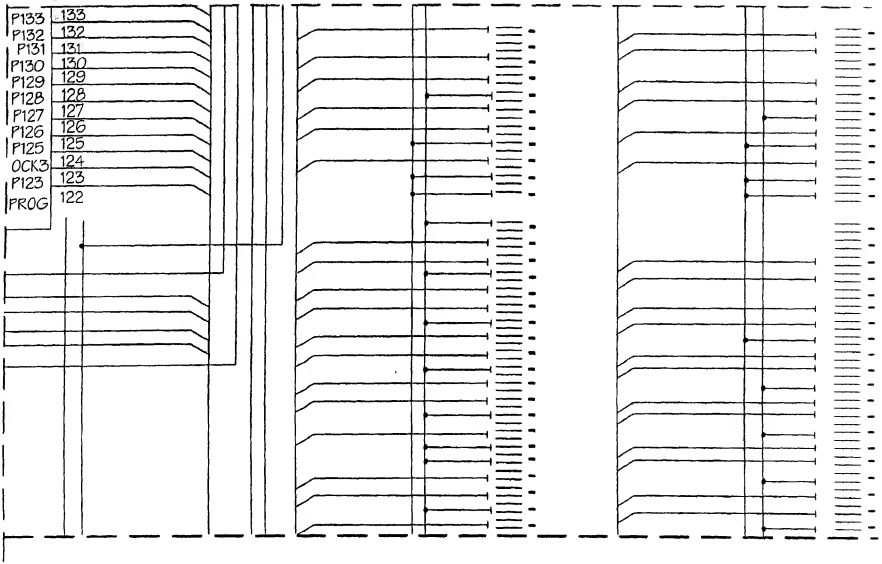

P133 133
P132 132
P131 131
P130 130
P129 129
P128 128
P127 127
P126 126
P125 125
OCK3 124
P123 123
PROG 122

FIG. 62(L)

20120° 29802001

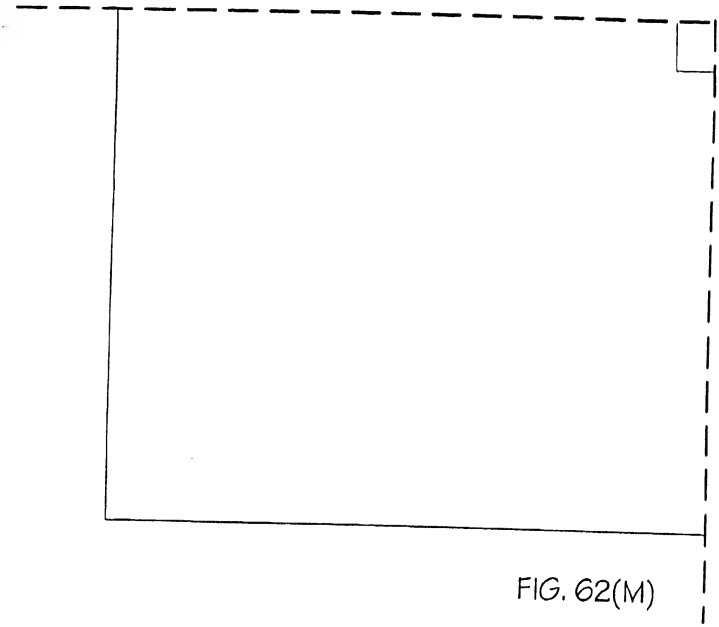


FIG. 62(M)

20120 29802001

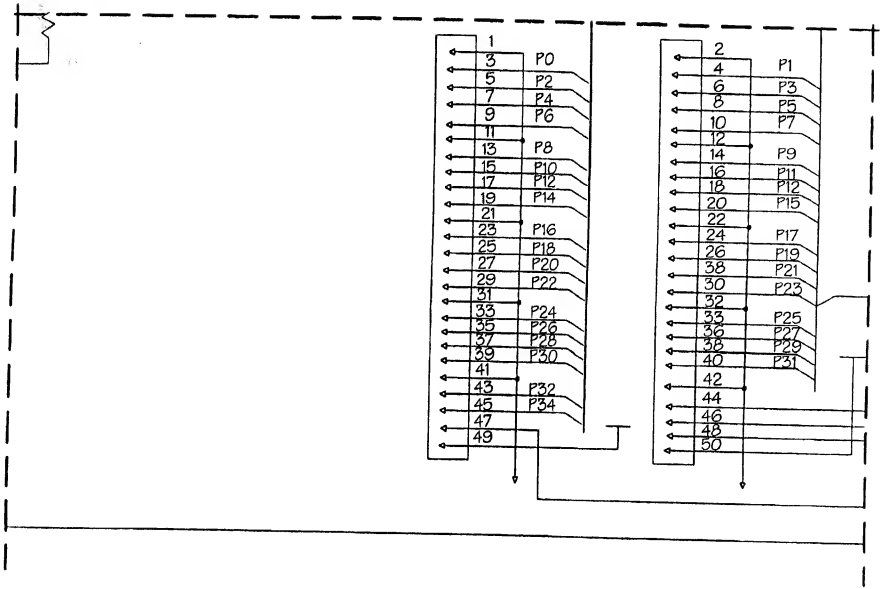


FIG. 62(N)

20120 25802001

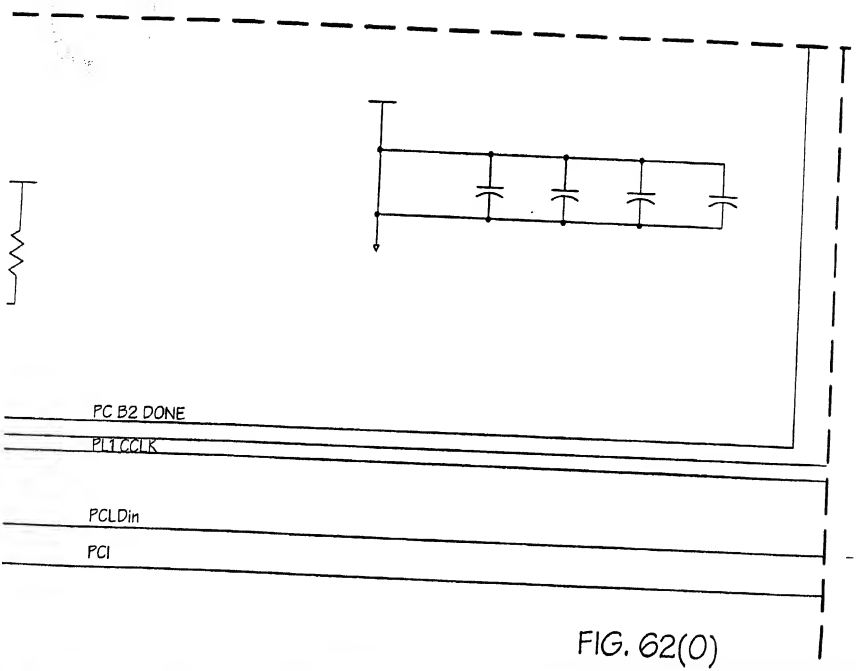


FIG. 62(0)

20120210-29802001

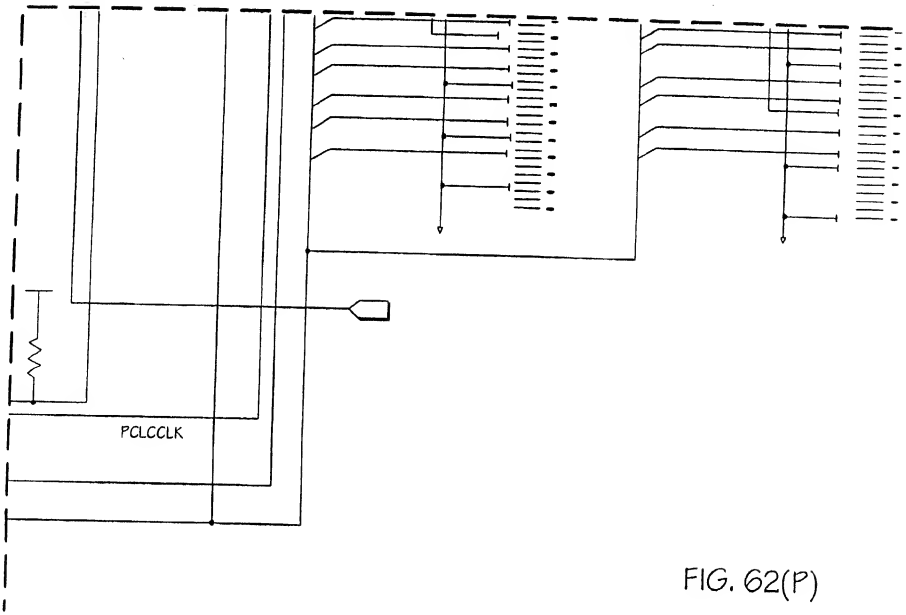


FIG. 62(P)

2012E0°29802001

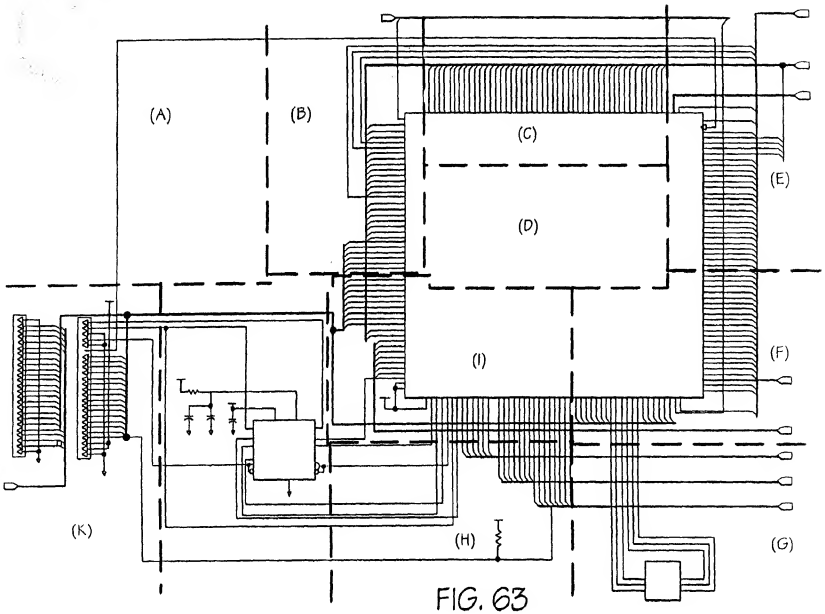


FIG. 63

20120852.0321.02

FIG. 63(A)

20120-2980200A

FIG. 63(B)

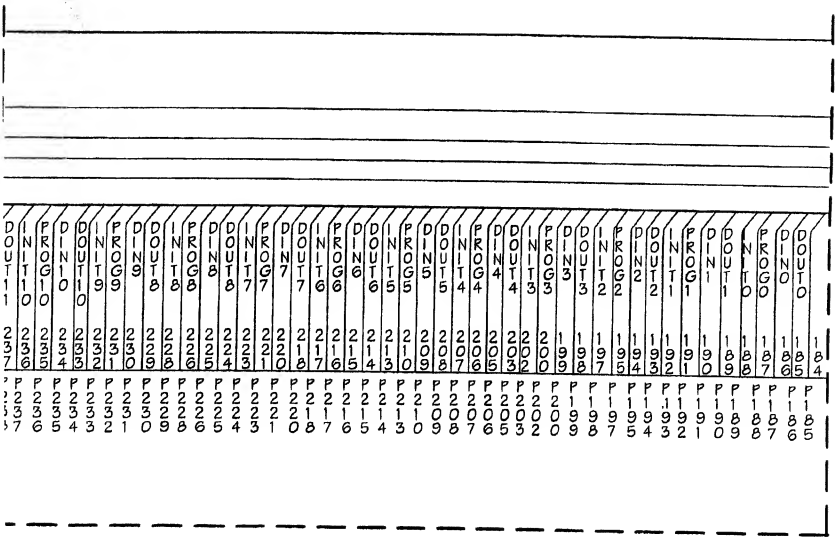

DOUT11
INIT10
PROG10
DIN10
DOUT10
INIT9
PROG9
DIN9
DOUT8
INIT8
PROG8
DIN8
DOUT8
INIT7
PROG7
DIN7
DOUT7
INIT6
PROG6
DIN6
DOUT6
INIT5
PROG5
DIN5
DOUT5
INIT4
PROG4
DIN4
DOUT4
INIT3
PROG3
DIN3
DOUT3
INIT2
PROG2
DIN2
DOUT2
INIT1
PROG1
DIN1
DOUT1
INITO
PROGO
DINO
DOUTO
2237
2236
2235
2234
2233
2232
2231
2230
2229
2228
2226
2225
2224
2223
2221
2220
2218
2217
2216
2215
2214
2213
2210
2209
2208
2207
2206
2205
2203
2200
1998
1997
1995
1994
1993
1992
1991
1990
1989
1988
1987
1986
1985
1984
P2237
P2236
P2235
P2234
P2233
P2232
P2231
P2230
P2229
P2228
P2226
P2225
P2224
P2223
P2221
P2220
P2218
P2217
P2216
P2215
P2214
P2213
P2210
P2209
P2208
P2207
P2206
P2205
P2203
P2200
P1998
P1997
P1995
P1994
P1993
P1992
P1991
P1990
P1989
P1988
P1987
P1986
P1985

FIG. 63(C)

20120229802001

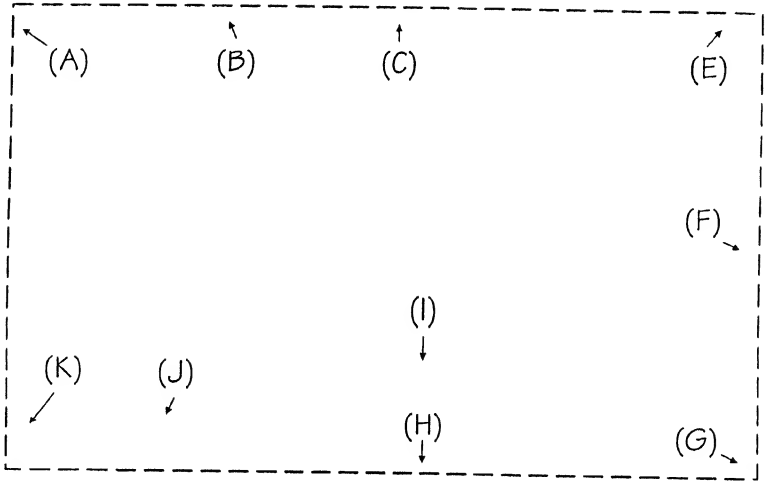


FIG. 63(D)

20120-25802001

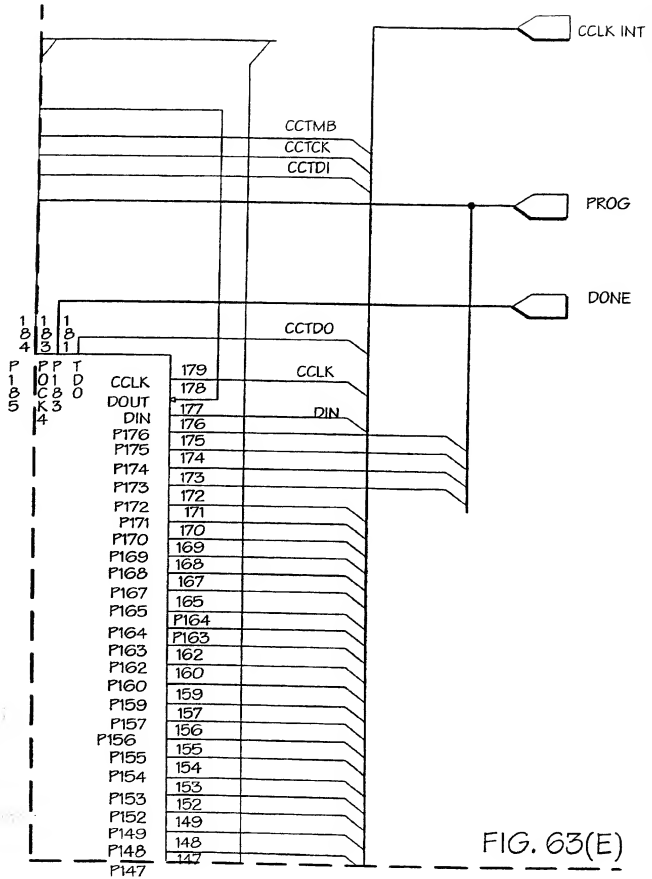


FIG. 63(E)

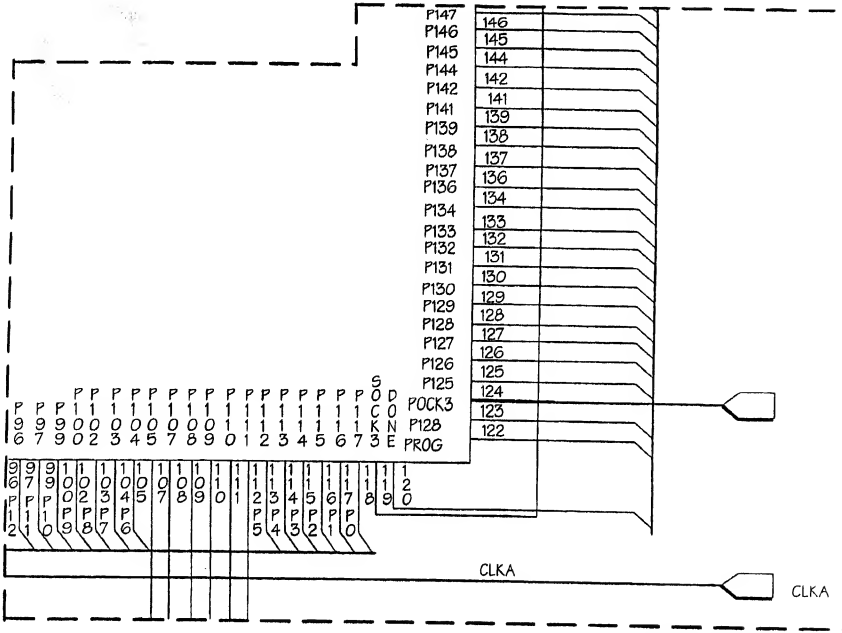

P147
P146
P145
P144
P142
P141
P139
P138
P137
P136
P134
P133
P132
P131
P130
P129
P128
P127
P126
P125
146
145
144
142
141
139
138
137
136
134
133
132
131
130
129
128
127
126
125
124
123
122
P96
P97
P99
P100
P102
P103
P104
P105
P107
P108
P109
P110
P111
P112
P113
P114
P115
P116
P117
SCK3
DONE
POCK3
P128
PROG
96 P12
97 P11
99 P10
100 P9
102 P8
103 P7
104 P6
105
107
108
109
110
111
112 P5
113 P4
114 P3
115 P2
116 P1
117 P0
118
119
120
CLKA
CLKA

FIG. 63(F)

20120802 29802001

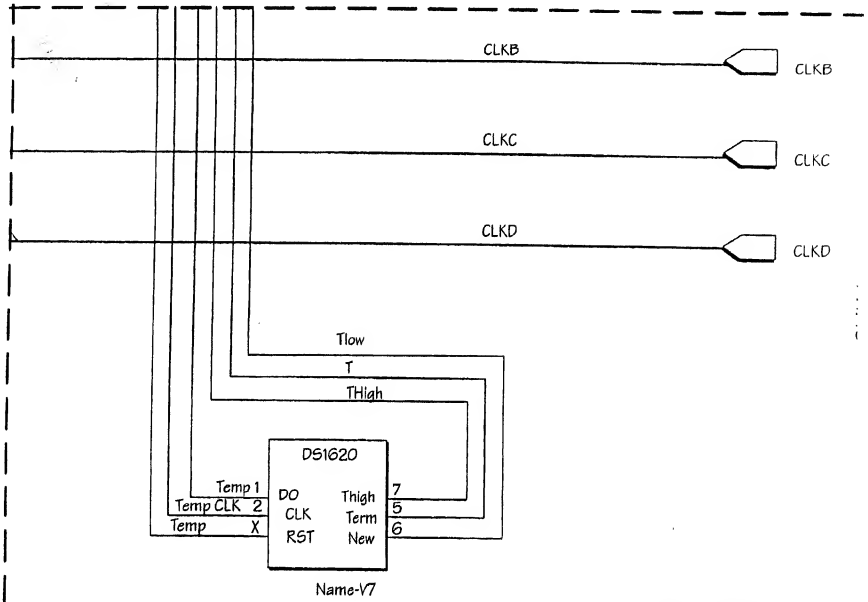


FIG. 63(G)

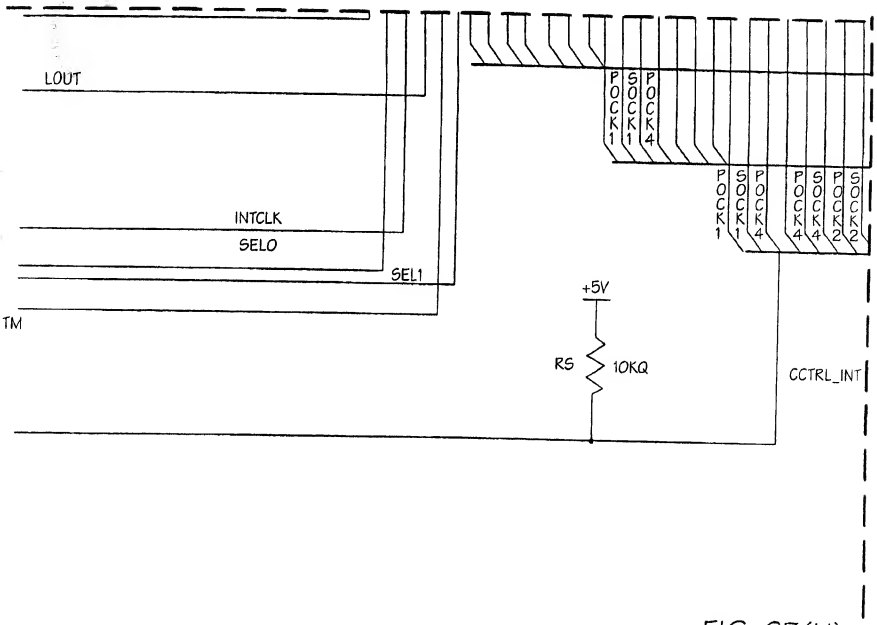

LOUT
INTCLK
SELO
SEL1
TM
+5V
RS
10KΩ
CCTRL_INT
POCK1
SOCK1
POCK4
POCK1
SOCK1
POCK4
POCK4
SOCK4
POCK2
SOCK2

FIG. 63(H)

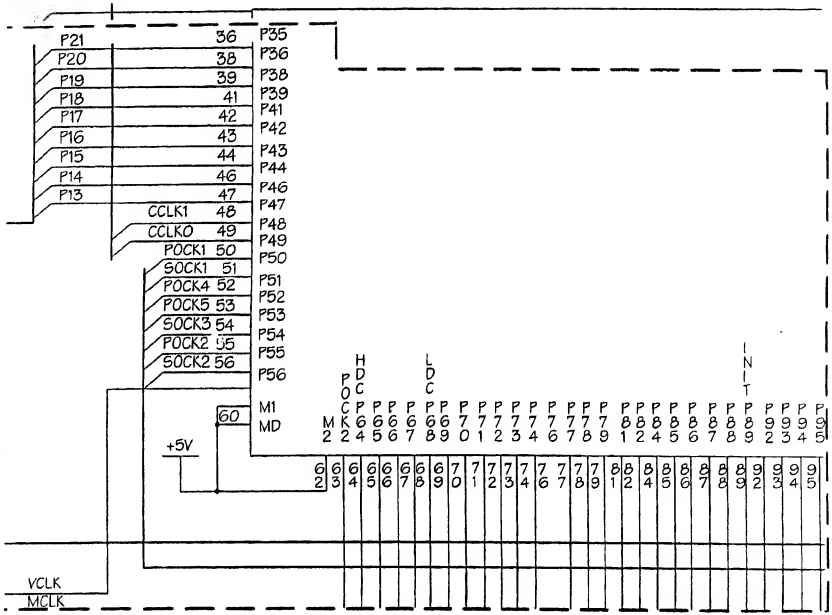
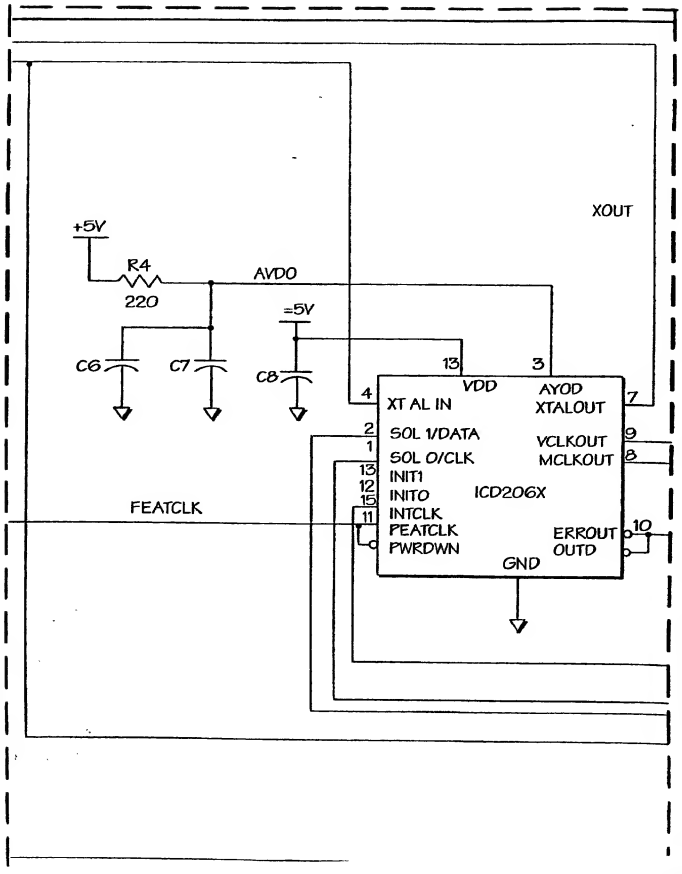

P21 36
P20 38
P19 39
P18 41
P17 42
P16 43
P15 44
P14 46
P13 47
CCLK1 48
CCLKO 49
POCK1 50
SOCK1 51
POCK4 52
POCK5 53
SOCK3 54
POCK2 55
SOCK2 56
P35
P36
P38
P39
P41
P42
P43
P44
P46
P47
P48
P49
P50
P51
P52
P53
P54
P55
P56
M1
MD
60
+5V
M2 POCK2 HDC P63 P64 P65 P66 P67 LDC P68 P69 P70 P71 P72 P73 P74 P76 P77 P78 P79 P81 P82 P84 P85 P86 P87 P88 INIT P89 P92 P93 P94 P95
62 63 64 65 66 67 68 69 70 71 72 73 74 76 77 78 79 81 82 84 85 86 87 88 89 92 93 94 95
VCLK
MCLK

FIG. 63(I)

2012X0-2980201



20124.0-2580200

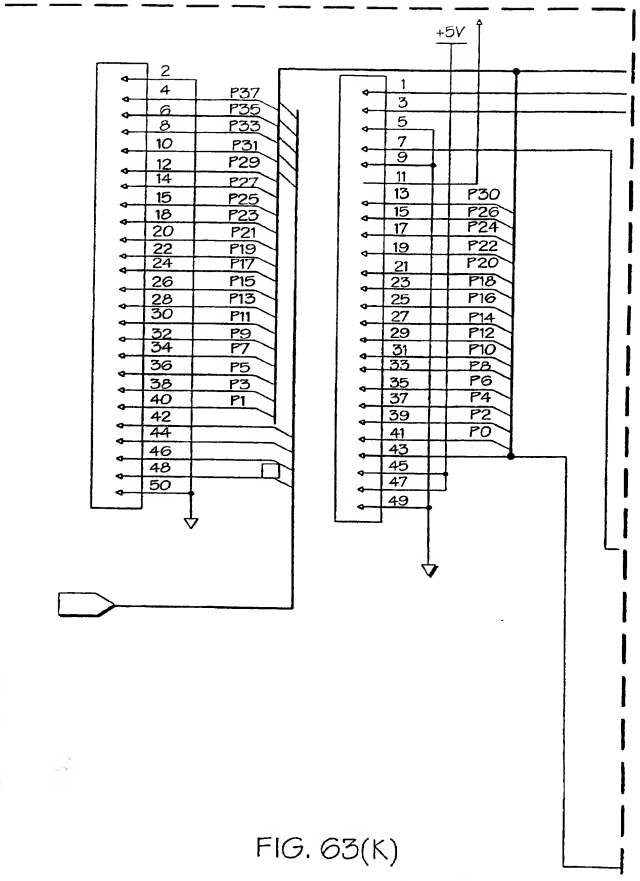


FIG. 63(K)

20120-2502201

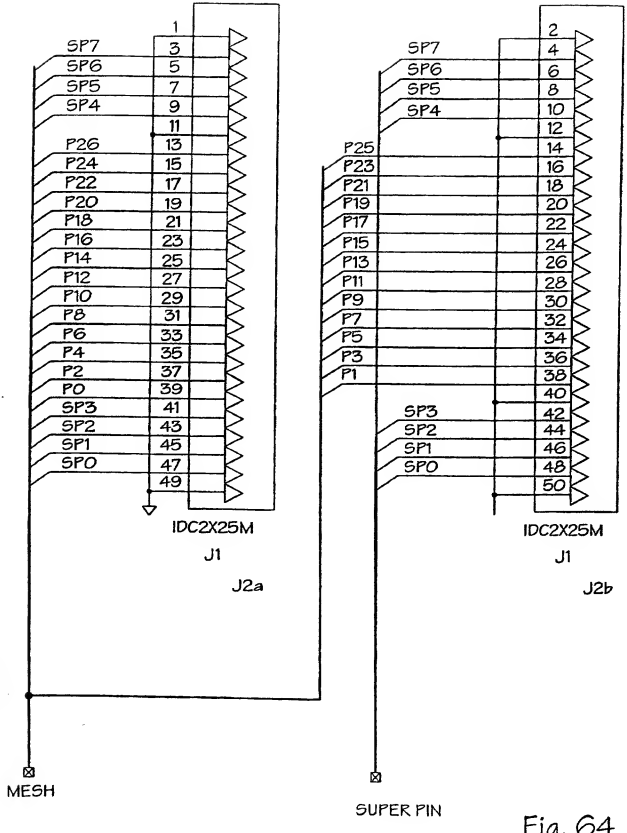


Fig. 64

20123.0.2580200.1

20120210-2980201

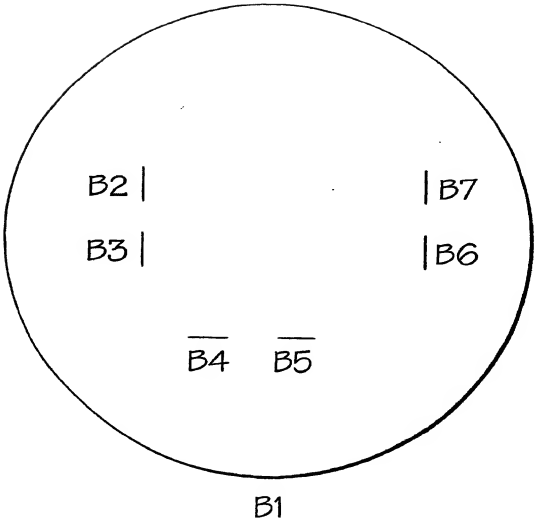


FIG. 66

20120302-0022580001

20120852-032102

FIG. 2C

20020852-032102

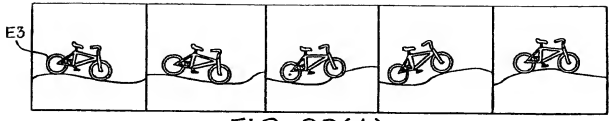


FIG. 69(A)

FIG. 69(B)

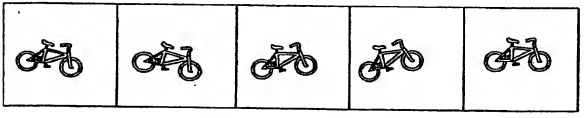


FIG. 69(C)

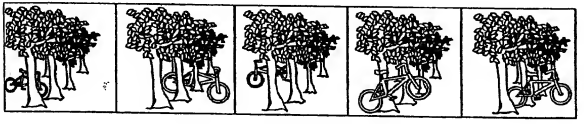


FIG. 69(D)